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CANADIAN ELECTRONICS ENGINEERING

Fundamentals of growth and decay in electrical circuits

Canada's top-side sounder satellite will probe ionosphere

Thermoelectricity: new design concepts in cooling equipment

ISA International Instrument-Automation Conference & Exhibit

CW MAGNETRONS

attuned to new applications

This Litton continuous wave magnetron is one of a family of ten that gives coverage from P to X bands at minimum power outputs from 250-500 watts.

The dependability and versatility of Litton CW magnetrons has been time-proved by the many thousands in field service. There are undoubtedly long years of operation ahead in new military and commercial applications.

These Litton CW magnetrons are mechanically-tuned and liquid-cooled. We also manufacture CW magnetrons with versatile hydraulic tuning and, at lower powers, can supply them with forced air cooling.

Litton CW magnetrons are being applied in a pulse width modulated navigation system. Pulse rate, amplitude and frequency modulation techniques make possible other communication applications. This family also offers many advantages in such CW applications as RF drivers, industrial processing and component testing. They can be pulsed to approximately 2 KW peak power at a .25 duty cycle, a desirable attribute in component testing.

Investigation of these magnetrons and Litton pulse magnetrons, the international standards of excellence, may lead you to new applications. If we have stimulated your thinking a little, we *would* like to hear from you. Write to: 960 Industrial Road, San Carlos, California.

CW MAGNETRONS

Type Number	Frequency Range Megacycles	Minimum Power Watts
L-3456	350-590	500
L-3459	590-975	500
L-3465	975-1500	400
L-3464	1500-2350	400
L-3460	2350-3575	500
L-3461	3575-4975	400
L-3467	4975-6175	400
L-3468	6175-7275	300
L-3462	7275-8775	300
L-3463	8775-10,475	250

LITTON INDUSTRIES
Electron Tube Division
MICROWAVE TUBES AND DISPLAY DEVICES

"Capability that can change your planning"

For further information mark No. 42 on Readers' Service Card

CANADIAN ELECTRONICS ENGINEERING

Volume five number 5 May 1961

Radio tube importers distort the facts Editorial comment 37

Canadian Electronics Engineering's guide to the

ISA International Instrument-Automation Conference and Exhibit 38

This important event will be held in Toronto June 5-8, with technical sessions in the Royal York Hotel and exhibits in the Queen Elizabeth Building, Exhibition Park. Here is a preview of the technical program and exhibits.

Growth and decay in electrical circuits 42

This article is the result of a thorough investigation of the theory of growth and decay in electrical circuits, which was prompted by an examination of the apparent anomalies in the geometrical properties of the functions involved. The scope of the investigation is limited to simple series combinations of passive components.

W. H. Sheppard attended Woolwich Polytechnic in London, England and graduated from London University in electrical engineering in 1937. Apart from seven years of teaching in various technical institutes, he has spent most of his career in the aircraft industry. Mr. Sheppard is now a demonstrator in the Department of Mechanical Engineering at McGill University.

Canada's top-side sounder satellite will probe ionosphere next year 46

DRB scientists, in collaboration with NRC and the U. S. National Aeronautics and Space Administration, have developed a Canadian satellite that will be used for ionosphere top-side soundings in 1962. The special antennas (see photo) will be tested later this year.

Thermoelectricity permits new design concepts in cooling equipment 48

A laboratory cooler has been developed which uses standard thermoelectric modules and can provide temperatures down to —20 C. It will hold an 800-mL beaker and keep the contents below zero C. The unit can also be used as an oven, providing temperatures up to 100 C.

James Keane is a graduate of Kevin College of Science and Technology, Dublin, Eire. After two years with Pye Telecommunications Ltd., Cambridge on transmitter design and a year of design work at Mullard Equipment Ltd., London, he came to Canada and worked on semiconductor test instrument design at Northern Electric Co. Ltd. Mr. Keane is now with Needco, Montreal.

IRE International Convention: New solid state devices enter the market 51

North America's major electronics event of the year is the Institute of Radio Engineers' International Convention. Present at the recent meetings were Dr. L. V. Berkner, centre, president of IRE, with vice-presidents John F. Byrne, left, and Dr. Franz Ollendorff, right.

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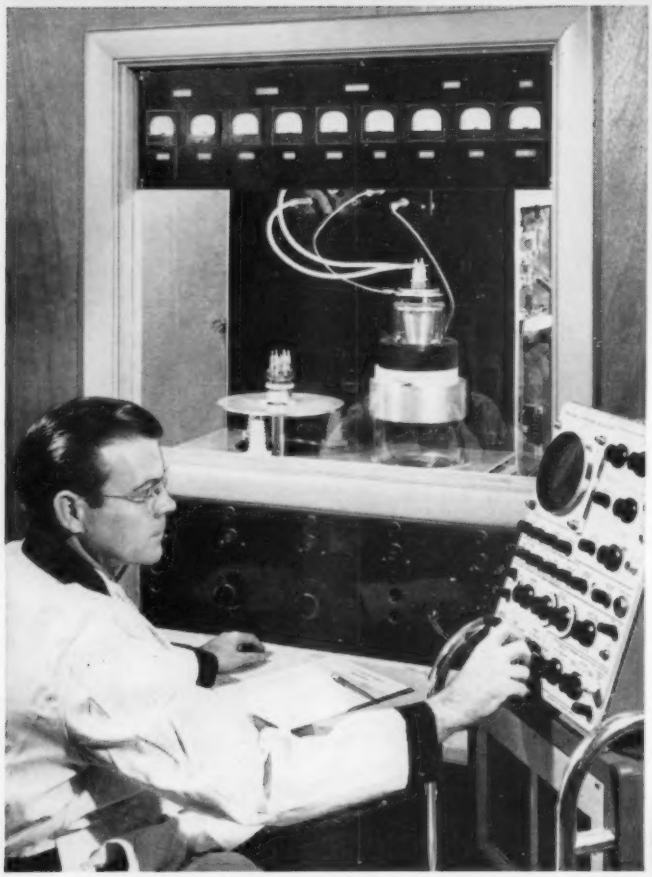
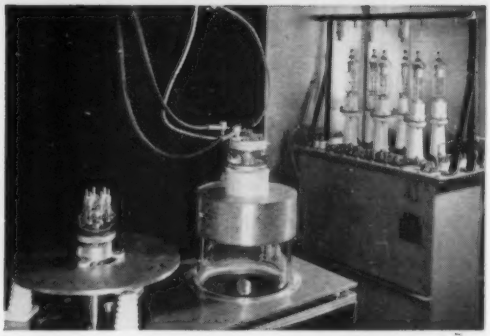
Marconi Announces

COMPLETE NEW TEST LAB FOR PRE-TESTING SPECIAL PURPOSE TUBES RIGHT HERE IN CANADA





Shown here is the high-voltage power supply —work horse of the new Marconi Test Lab in Toronto. Test facilities are available for testing either air, water or vapour-cooled high-power electron tubes up to 200 kw. with static power of 25 kw.

The Lab tests all Special Purpose Tubes for manufacturing defects, or for damage caused in storage or in shipping from the manufacturer. At left, an oscilloscope takes pulse measurements of a BR1102 Tube. Tests are made under simulated operating conditions. Every detail is carefully checked before tubes are shipped...sealed and protected by the Marconi warranty.

Now, annoying lengthy delays and inconveniences caused by faulty Special Purpose Tubes are the thing of the past. No longer need you wait—and *wait*—while these tubes are sent back to the manufacturer—often in the U.S. or Europe—for repair or adjustment.

For Canadian Marconi's new Special Purpose Tube Test Lab, only one of its kind in Canada, is centrally located in Toronto for faster customer service. All tubes are fully tested in the lab before they are shipped out to you. This guards against the possibility of your getting a defective tube. Should any trouble occur on a Marconi Tube, you can be sure of immediate warranty adjustment.

And Marconi experience stands behind Marconi service! Should you have any problems regarding your Special Purpose Tube, a Marconi electronics specialist will be glad to help you out. Just give us a call.

ELECTRONIC TUBE AND COMPONENTS DIVISION

CANADIAN **Marconi** COMPANY

1830 BAYVIEW AVENUE, TORONTO, ONTARIO

Branches: Vancouver • Winnipeg • Montreal • Halifax

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Authorized as second class mail, Post Office Department, Ottawa.

Printed and published by Maclean-Hunter Publishing Company Limited, 481 University Avenue, Toronto 2, Canada. Address all correspondence: P.O. Box 100, Terminal A, Toronto, Canada. Tel.: 362-5311.

Offices at 1242 Peel Street, Montreal, UN. 6-9841; Room 1004, The Burrard Bldg., 1030 West Georgia Street, Vancouver 5, B.C. MU. 3-8254; Maclean-Hunter Limited, 30 Old Burlington St., London W. 1, England.

Horace T. Hunter, Chairman of the Board; Floyd S. Chalmers, President; Donald F. Hunter, Vice-President and Managing Director.

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Other services: The Financial Post Corporation Service; Canadian Press Clipping Service; Commercial Printing Division.

Subscription rates: Canada $5.00 per year, two years $9.00, three years $13.00. Single copy price $1.00. U. S. A., United Kingdom, $10.00 per year; all other countries, $30.00 per year.

Indexed in Engineering Index.

Member Canadian Circulations Audit Board, Inc.

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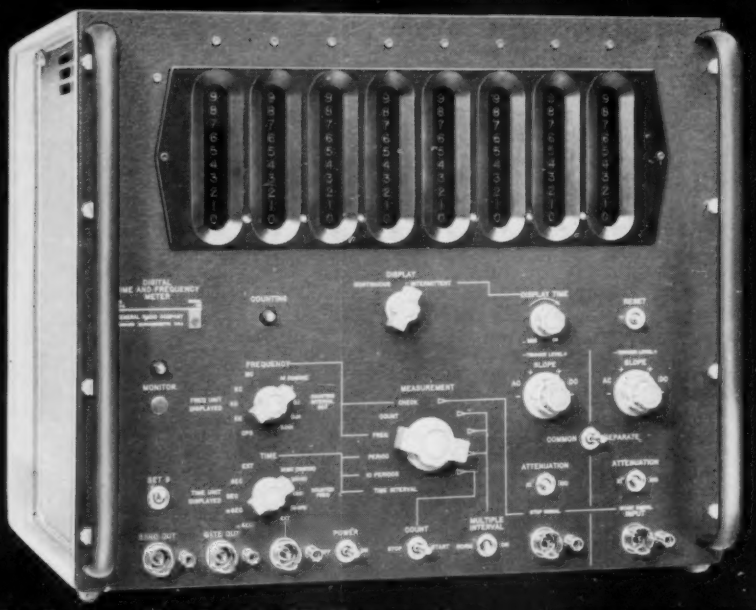

the Counter with a Memory

Continuous Readout to 10 Megacycles

The "memory" in this Counter constitutes an important new operating aid. Four of the instrument's eight decades are used for storage and continuous display, while the remaining four decades count continuously. At the end of each counting interval, the total accumulated by the counting decades is transferred automatically and quickly (only 100 μsec) to the storage and display decades. Continuous counting offers many advantages – information is sampled more often; frequency adjustments become easy; analog recording is greatly simplified; and operator eye fatigue induced by the dancing lights of intermittent displays is eliminated.

The Type 1130-A Digital Time and Frequency Meter is not just another counter. It embodies a number of new engineering contributions that are of fundamental importance.

This instrument is designed like a digital computer — to achieve a uniform level of high reliability throughout. "Down time", the bugaboo that robs the user of his full investment, is at a minimum.

Unsurpassed reliability is achieved by:

1. New decade codes and high-speed counting circuits, *unlike those in other counters*, that make this instrument inherently reliable.
2. Circuits designed to operate properly under the worst combination of *cumulative* tolerances imposed by tubes, component values, and voltage levels. Counter *performs properly even with tubes approaching the half-dead state.*
3. Use of proven "hard-bottoming" multivibrator dividers that make for exceptional stability — eliminate need for periodic adjustments of time-base circuits.
4. Elimination of critical voltages. Neither plate nor filament supplies are, or need be, regulated.

RANGES:
Frequency: dc to 10 Mc
Period: 10 μsec to 10^7 sec
Time Interval: 1 μsec to 10^7 sec
Also measures 10 periods, frequency ratios, phase shifts, pulse characteristics, and counts random events.

SENSITIVITY:
0.25v rms

DISPLAY
4 digits continuous; 8 digits for sequential counting and display, with display-time variable from 0.1 to 10 sec.

ACCURACY:
±1 count ± time-base oscillator stability

AVAILABLE WITH SEVERAL PLUG-IN TIME-BASE OSCILLATORS

Buy the Time-Base Stability You Need

	Complete Instrument Type - Price	Short-Term Stability Better Than	Long-Term Stability Better Than
Completely Self-Contained	1130-A4, $2,950.	1 part in 10^9 per min.	5 parts in 10^8 per week
	1130-A3, $2,670.	1 part in 10^8 per min.	2 parts in 10^7 per week
For Use from External Standards	1130-A2, $2,750.	——— Same as 1130-A3 ——— Also operates from external 100-kc, 1-Mc, and 5-Mc inputs.	
	1130-A1, $2,585.	Requires 5-Mc driving signal; G-R 1113-A 5-Mc Standard Frequency Oscillator provides stability of 1 part in 10^{10} per min, 2 parts in 10^9 per week.	

For Digital Recording

1132-A Data Printer . . . $1450.
Records 8 digits from counter plus 4 digits from clock or other source, at speeds to 3 prints per sec . . . no modification of counter is required

For Graphic Recording

1134-A Digital-to-Analog Converter . . . $595
Makes possible low-cost, ALL-ELECTRONIC graphic strip-chart recording (no data printer needed) . . . high accuracy of 0.1%

For Measurements to 500 Mc
Frequency conversion units are under development

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NEWS HIGHLIGHTS

EIA charges Japanese exporters with "looting" Canadian consumer market for radios and entertainment tubes, launches counter-attack to disclose damage done to electronics industry.

Representatives of the Electronic Industries Association of Canada met with the Prime Minister and three cabinet ministers last December 8, and with Finance Minister Fleming and three of his economic experts on April 7, to discuss the problems faced by the industry. The arguments and supporting statistics used in these presentations to the government have now been released in a 45-page brief with nine appendices.

It points out that Japan has seized domination of the high-volume Canadian market for radios and tubes, called "the life-blood of the electronics industry," by flooding it with products with a false "fair-market" value. It also claims that the Canadian industry is "being ground to complete frustration" by the fantastic growth of these subsidized imports from Japan and blames the Canadian Government's short-term import-export policy.

To reveal the damage done by Japanese invasion of the profitable consumer field, the industry presents the following facts, based largely on the Canadian Government's own DBS figures:

— Since 1950, Canadian consumption of radios has doubled.

— Almost unbelievably, in the same period Canadian manufacturers' shipments to the Canadian market have dropped!

— In the same period again, imports of radios have increased "fantastically" — from 2,826 units to 731,511 units — with 70% of them from Japan.

— Electronic tubes are the nucleus of all electronic equipment, but Canadian production of tubes is facing imminent collapse due to Japanese imports.

— Since 1956 — in just five years — the Canadian electronics work force has dropped from 25,000 to 18,000 — a 28% loss of jobs.

"The result has been such a strangulation of the Canadian electronic manufacturer that sufficient money cannot be found for research and development, and in this industry you either keep pace with new advances or die," said W. H. Jeffery, vice-president of Philco Corporation of Canada, who heads the EIA committee on the industry's problems.

The landed price the Japanese exporters set is so low through behind-the-scene subsidies that the mark-ups enjoyed by distributors permit them both to take an exorbitant profit and also to substantially dominate the Canadian market.

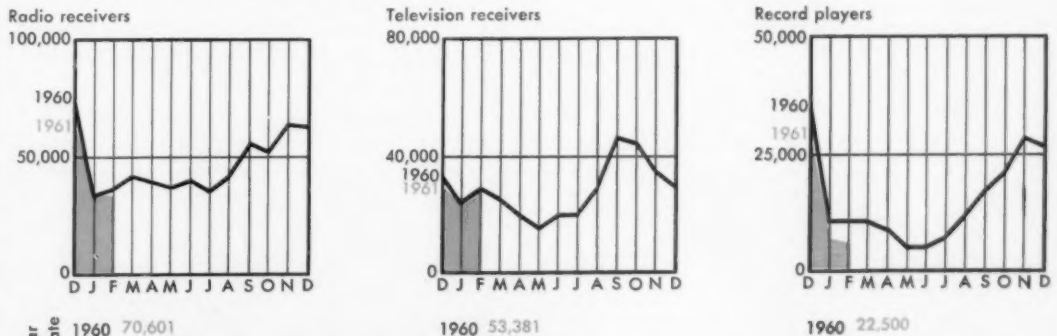
The brief states that the basis on which Japanese tubes enter Canada is suspect by the figures of the Japanese Government itself. The "fair market" unit value stated to Canada for purposes of duty and taxes is 31 cents. But the statistics published by Japan's Ministry of International Trade and Industry indicate the unit value of "miniature and other types of receiving tubes" to be 60.6 cents. This is considered "bare-faced dumping" by the Canadian industry, which terms it "iniquitous and intolerable."

The brief also reveals details of the Japanese "Link System" by which its exporters are so profitably subsidized that they can exploit the Canadian market for consumer-type radios and tubes on a basis of price only.

The industry declares that the Canadian Government has the responsibility to protect it — "not by shallow short-term limitations on imports," but by a solid, permanent policy that will create a feeling of optimism and security.

(See editorial comment on page 37)

Radio and tv still holding up, but record players down 38%



Year to date

	Radio receivers	Television receivers	Record players
1960	70,601	53,381	22,500
1961	66,257	52,567	14,027

Distributor sales to dealers, in units

Source: EIA of Canada / Charts: CEE

SPAT*

PHILCO ANNOUNCES A COMPLETELY NEW FAMILY OF PNP SILICON TRANSISTORS WITH HIGH VOLTAGE . . . HIGH BETA IN TO-18 PACKAGE

TO-18 CASE

Produced by the Exclusive New Philco Strip Alloying Process

*Trademark Philco Corp. for Silicon Precision Alloy Transistor

TYPE NO.	MAX. RATINGS V_{CBO}	MAX. RATINGS P_{DISS}	CHARACTERISTICS I_{CBO} (10v) MAX.	CHARACTERISTICS h_{fe} (6v, 1ma) MIN.	CHARACTERISTICS h_{fe} (6v, 1ma) MAX.	CHARACTERISTICS f_T (6v, 1ma) MIN.
2N858	40v	150 mw	0.1 μa	15	75	5 mc
2N859	40v	150	0.1	30	120	6
2N860	25v	150	0.1	15	45	6.5
2N861	25v	150	0.1	30	100	7.5
2N862	15v	150	0.1	20	60	8
2N863	15v	150	0.1	40	120	10
2N864	6v	150	0.1 (6v)	25	125	16
2N865	10v	150	0.1	100	350	24

Completely new to the industry, these Philco Silicon Precision Alloy Transistors meet a widespread need for medium frequency, high voltage, high beta silicon transistors for both switching and amplifying applications. An exclusive new production technique . . . strip alloying . . . permits accurate measurement of the diode voltage rating and beta of every transistor during the manufacturing process. Never before has such close control in production been possible.

The new SPAT family offers low saturation voltage and high emitter base diode voltage rating. For complete information, write Dept. EDN161.

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TRANSISTOR DISTRIBUTORS—TORONTO—Electro Sonic, 543 Yonge St. ●MONTREAL—Canadian Electrical Supply, 275 Craig St.
MARITIMES—Commercial Equipment Limited, 12 King St., Saint John, N.

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F. Fulton appointed vice president at Northern Electric Co. Ltd.

Fraser F. Fulton, OBE, has been appointed vice president, industrial and public relations, Northern Electric Co. Ltd., succeeding H. McD. Sparks, who is retiring.

Born in St. John, N.B., Mr. Fulton received his certificate in engineering from Mount Allison University in 1926 and subsequently graduated from McGill with a BSc degree in electrical engineering. He began his career with Northern Electric in 1927 as a sales engineer.

At the outbreak of World War 2, Mr. Fulton joined the Royal Canadian Corps of Signals with the rank of Lieutenant. He served in England, North Africa, Italy and North West Europe as chief technical officer for the Canadian Army overseas, attaining the rank of Brigadier.

After his demobilization, Mr. Fulton resumed his activities with the Company and was appointed chief engineer of the electronics division and, three years later, government contracts manager. In 1950 he became manager of the Company's Belleville Works and the following year, assistant to the vice-president and managing director.

Mr. Fulton rejoined the sales division in 1952, becoming general manager in 1954. He was appointed general manager of the telephone contract division in 1957 and vice-president and general manager of the division in 1960.

Fulton

Fromanger

Heading up the new silicon rectifier department of Syntron (Canada) Ltd., Stoney Creek, Ont., is Armand Fromanger.

Mr. Fromanger, formerly sales manager in charge of marketing for the company's Canadian-made rectifier elements, has completed an extensive study of the latest processes and techniques in the manufacture of double vapour diffused junctions. The study was made at Syntron laboratories and the Mellon Institute in Pittsburgh.

J. Hampton has been appointed sales manager for the Province of Ontario at the Electronics Division of Astral Electric Co. Ltd., Scarborough.

Mr. Hampton came to Canada from the United Kingdom four years ago, where he was with Tannoy Products Ltd. and Decca Navigator Co. Ltd. Since that time he has been associated with Tannoy (Canada) Ltd., Toronto.

Waghorne

Hampton

J. H. Waghorne, P.Eng., of Toronto has been appointed chairman of the certification board for engineering technicians and technologists in Ontario. He succeeds Dr. George B. Langford, P.Eng., also of Toronto, who served as chairman since the board was established three years ago.

Mr. Waghorne, born at Sarnia, Ont., is a graduate in engineering physics from Queen's University. He received his Master's degree in 1940 from the same university. In business life, he is engineer-in-charge of the electrical research department, Ontario Hydro. He has been associated with the department since 1940 with the exception of two and a half years (1942-45) spent as a lecturer in electrical engineering at the University of Alberta. Mr. Waghorne is a former vice-president of the Association of Professional Engineers of Ontario.

R. French has been appointed sales representative for the Maritime Provinces, province of Quebec and city of Ottawa by Sola-Basic Products Ltd.

Shortly after coming to Canada from Belfast, Northern Ireland, Mr. French joined Sola-Basic Products Ltd. at its head office in Toronto. For his new duties he will be located in Montreal.

G. Frederick Barlow, assistant chief of sales and traffic services at Canadian National Telecommunications headquarters, Toronto, died recently.

Born in England, Mr. Barlow started service in 1917 with the Great North Western Telegraph Co. at Toronto as an automatic telegraph operator and remained with the successor company, CNT, for more than 30 years.

During that time Mr. Barlow was actively engaged in the development of telegraph systems and procedures. In more recent years he was concerned primarily with system planning in the general office of CNT. He also participated in the introduction of Telex to North America. He was 60 years old at the time of his death.

Arthur L. Ross will head data processing at Farrington Manufacturing Co.

Mr. Ross, former president of Square D Co. of Canada Ltd., Toronto, has been elected senior vice-president of Farrington Manufacturing Co., Needham Heights, Mass. He will be responsible for co-ordinating activities of Farrington subsidiaries involved in data processing.

Born in Sault Ste. Marie, Ont., Mr. Ross is a graduate of McGill University. He supervised a Canadian shell-filling plant during World War 2. In 1948 he became assistant director of Ontario Hydro's frequency standardization program, then joined Square D seven years ago.

Two additional men have been added to the sales staff of Atlas Radio Corp. Ltd. They are Alec "Chic" Langdale and Jack Heslop.

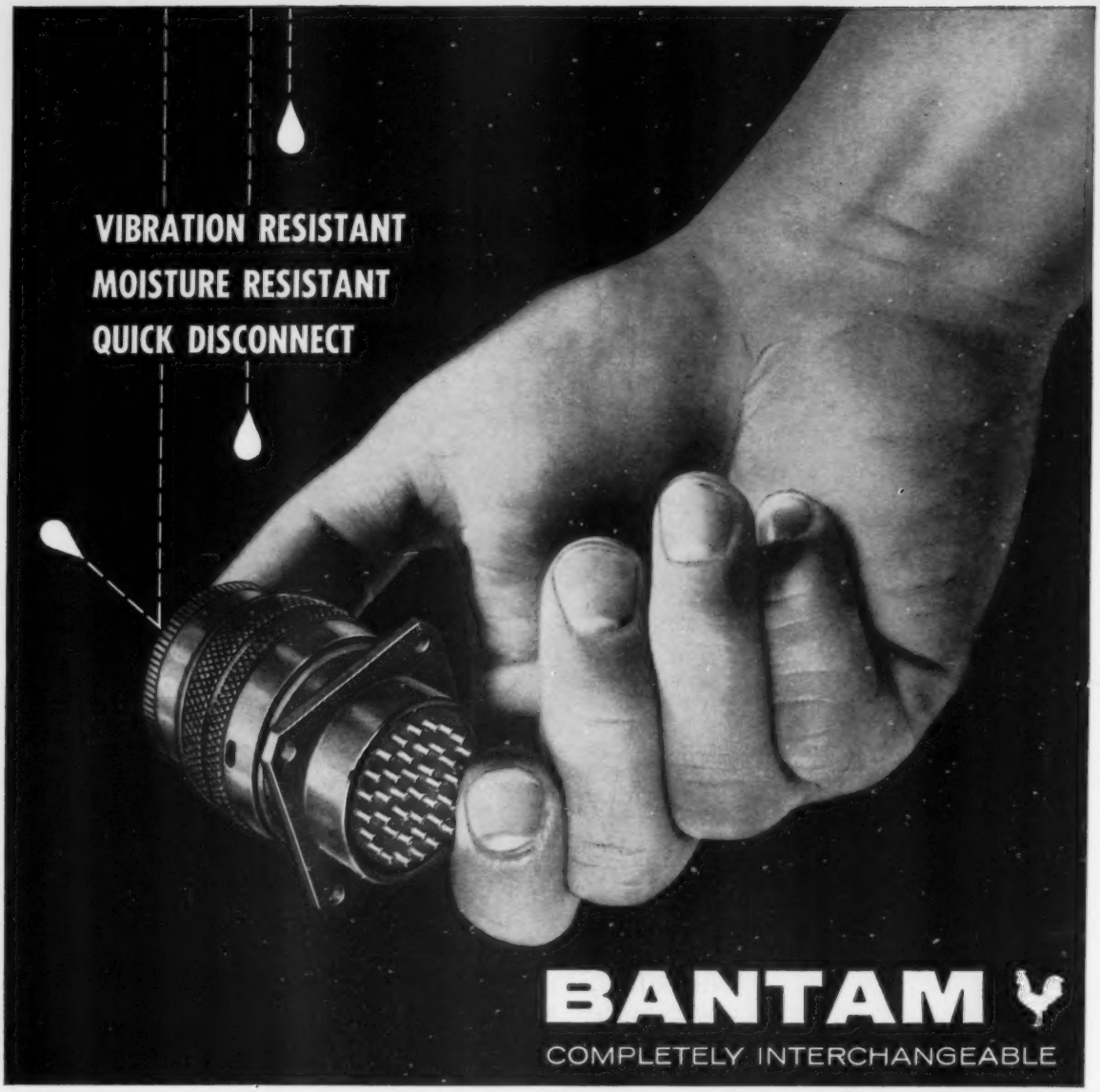
Mr. Langdale will serve industrial accounts in Ontario. Prior to his appointment to sales in Atlas Radio Corp. Ltd., he was in charge of sales promotion for Atlas Instrument Corp. Ltd. Since his discharge from the Canadian Army he has operated his own business designing and building electronic displays; been employed by Moffats Ltd., designing displays; supervised the technical publications group at Canadian Radio Manufacturing; directed technical publications services at C. A. Meadows and Associates.

Heslop

Langdale

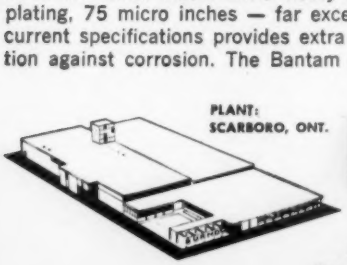
Mr. Heslop will be serving both distributor and industrial accounts in Manitoba and Saskatchewan. For the past nine years he has been parts and service manager for Great West Electric & Radio, in Regina, where he has been handling products from Atlas Radio Corp. Ltd.

(Continued on page 62)



miniature solder connectors certified to MIL-C-26482 (ASG)

Up to 32 contacts in an area the size of a ... providing for 61 contacts in an area slightly larger, the Bantam line is available in a wide variety of insert configurations and shell sizes. Extra heavy gold plating, 75 micro inches — far exceeding current specifications provides extra protection against corrosion. The Bantam contacts also provide hard gold mating against soft gold adding durability and minimizing galling. An exclusive wire-seal grommet will seal all required wires and in addition type EE Mil-W-16878. Electrically, mechanically, BANTAM connectors have proven completely dependable. Copper alloy closed entry sockets, extra heavily gold-plated over silver... moisture-proof resilient inserts... cadmium-plated shells of impact-extruded aluminum... heavy spring tension for perfect interface sealing.



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Burroughs consolidates and expands its Canadian operations

Consolidation of Burroughs marketing and manufacturing operations in Canada under a new name, **Burroughs Business Machines Ltd.,** has been announced by Joseph L. Rapmund, president of the new company and formerly general manager of Burroughs Adding Machine of Canada Ltd.

Divisions include Windsor Mfg. (production of business machines); Supplies (carbon paper, inked ribbons and other business machine supplies—formerly Acme Carbon and Ribbon Division); Defence Systems Service (see below); and Equipment and Systems (marketing and operation of Ottawa data processing centre).

A $200,000 expansion of the Supplies Division operation in Scarborough, Ont. will involve a 20% plant enlargement and the acquisition of new machinery. Expansion of activities in the Defence Systems Service Division, which handles military contracts and installs and services military computers, will provide work for more than 100 additional men during 1961. Recruiting is now under way of electronics technicians and engineers who will receive formal training in a 22-week course at the Burroughs school in Toronto. Graduates of the first courses are now completing installation of the second computer for the Pinetree Line.

IBM 1401 users form new organization

Representatives of 25 companies met in Toronto recently to form an association of users of the new International Business Machines 1401 and 1410 computers. To be known as SPADE (Systems Planning and Development Exchange), the organization has been formed "to advance the effectiveness of utilization of the IBM 1401 and 1410 computers and their successors by promoting free interchange of information concerning the use of such machines."

SPADE will hold semi-annual general sessions and four standing committees will operate on a continuous basis. These are: 1401/1410 Systems and Programming (chairman, R. Ohora, Imperial Oil Ltd.); Machine Operations (H. F. Sagan, Texaco Canada Ltd.); Management and Administration (D. S. Payne, The Robert Simpson Co. Ltd.); Education and Training (A. L. Sokol, International Business Machines Co. Ltd.). Other officers include S. R. Pinder, Massey - Ferguson Ltd., president; B. G. Hawkins, Shell Oil Co. of Canada Ltd., vice-president; R. Cusack, Canadian Oil Companies Ltd., secretary; R. G. Rankine, Continental Can Co. of Canada Ltd., treasurer. All of these officers are located in Toronto.

The 1401 is a partially buffered transistorized machine that rents for about $2,500 per month for the basic package of computer, card punch, card reader and printer. The 1410 is a fully buffered system that is faster and has more memory capacity than the 1401. Nearly 200 of these machines are on order in Canada and deliveries will start shortly.

CGE reduces rectifier prices

Canadian General Electric Co. Ltd. has announced price reductions ranging from 22% to 46% on all 22 models comprising its two lines of silicon low current potted rectifier assemblies. These packaged rectifier circuits are high voltage types rated at up to 10,000 volts prv and 750 ma forward current per block.

(Continued on page 63)

Newly-elected SPADE organization executive plans activities. Left to right: Hawkins, Pinder (president), Cusack, Rankine, Sagan, Payne, Sokol, Ohora.

Ottawa report

Regulations have been published setting out standards under which manufacturers of new products can claim double depreciation for tax purposes on their productive machinery, basically equipment and buildings.

This concession applies to assets acquired after December 13, 1960, to produce what is termed "a product of a type not ordinarily produced in Canada."

A broad area of administrative discretion remains. The Trade Department, which will administer the regulations, prefers to make the generalized definition of a "new product" quoted above rather than attempt it in detail. Department officials say common sense will be the basis for judging what products are new and eligible for the concession.

The assets on which double depreciation can be charged are only those used "solely or chiefly for producing a new product." This excludes items such as office furniture, uniforms and the like which are for general company use.

The most important areas of double depreciation will be machinery and equipment (20% per year on the declining balance) and buildings which now depreciate at either 5% for permanent structures or 10% for temporary types. These do not include old assets used to manufacture new products, such as old tools or an old building.

Double depreciation can be counted in two ways:
(1) It can be applied in full for any one of the first three years of operation and
(2) It can be divided equally or unequally and spread over the three years.

In either case the depreciation concession can be taken up to the full normal allowance on the first year's operation.

Interested manufacturers should contact the Depreciation Certification Branch, Trade Department, Ottawa, for further information. Officials report some 100 letters have already been received naming some 50 products that may be eligible for the tax concession.

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Arnold offers you the widest range of shapes and sizes of iron powder cores on the market.

In addition to toroids, bobbin cores and cup cores—typical groups of which are illustrated below—Arnold also produces plain, sleeve and hollow cores, threaded cores and insert cores, etc., to suit your designs. Many standard sizes are carried in warehouse stock for prompt shipment, from prototype lots to production quantities. Facilities for special cores are available to order.

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● For more information on Arnold iron powder cores, write for a copy of our new 36-page Bulletin PC-109A. ***The Arnold Engineering Company, Main Office and Plant, Marengo, Illinois.***

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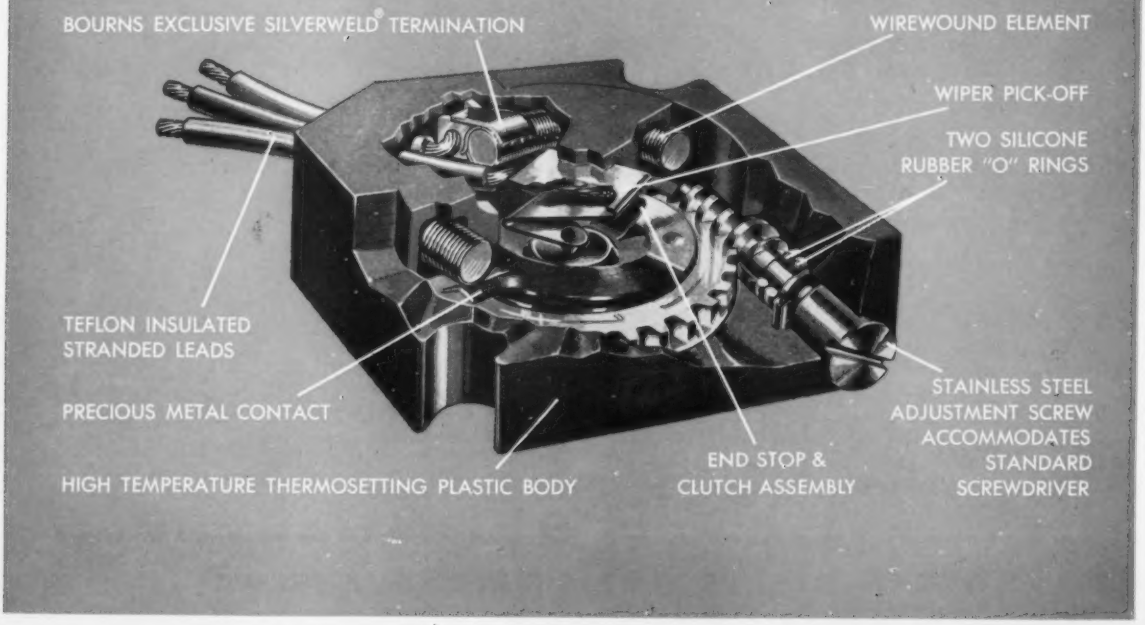
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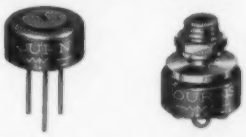
Subminiature Humidity-Proof Wirewound Trimpot — Model 3250. Operates at 175°C / L, 3 types of P terminals / 1 watt / 100 ohms to 50K. Meets Mil Specs for humidity.



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General-Purpose Resiston Carbon Humidity-Proof Trimpot—Model 235. Operates at 125°C / L, S, P terminals / 0.25 watt / 20K to 1 Meg. Meets Mil Specs for humidity.

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High-Quality Commercial Wirewound Trimit® — Models 271, 273, 275. Operate at 85°C / L, S, P terminals / 0.25 watt / 100 ohms to 10K. Resiston carbon versions also available, Models 272, 274, 276 / 20K to 1 Meg.

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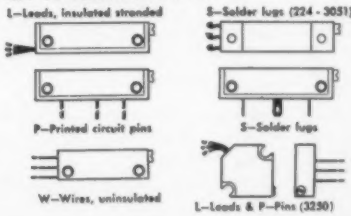
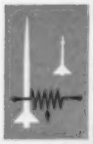
Write for detailed specifications and list of stocking distributors.

KEY TO TERMINAL TYPES:



STANDARD RESISTANCES (OHMS)

10	20	25K	50	100	200	500	1K	2K	5K
10K	20K	50K	100K	200K	500K	750K	1 Meg.		



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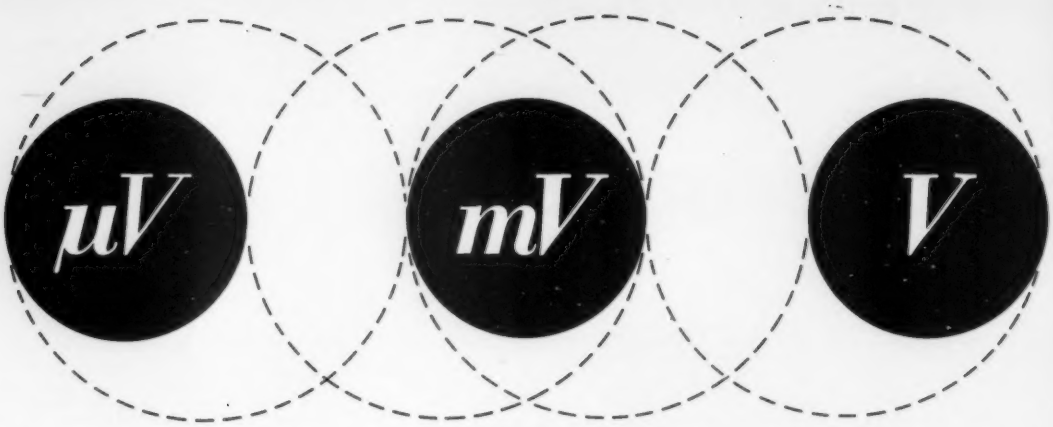

electronic millivoltmeters

internal calibration

It should be noted that all Philips electronic voltmeters contain calibration standards which enable the user easily and rapidly to check, and, if necessary, to re-calibrate his voltmeter at any time without the use of additional instruments.

VHF Voltmeter, type GM 6025

Frequency range: 0.1 Mc/s - 800 Mc/s
flat from 1 Mc/s - 300 Mc/s
−1 dB at 0.1 Mc/s
+1 dB at 800 Mc/s

Measuring range: 10 mV (f.s.d.) - 10 V divided into 7 ranges in a 1-3-10 sequence

Overall accuracy: Better than 5% of full scale

Input resistance: 65 kΩ at 1 Mc/s ; 50 kΩ at 100 Mc/s ; 35 kΩ at 200 Mc/s

Input capacitance: 1 μμF

Replacement of the probe crystal:
the probe crystal can be easily replaced and the instrument rapidly re-calibrated by the user

For measurements on 50Ω -coaxial lines the T-connector, type GM 6050T, can be ordered

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116 Vanderhoof Ave., Toronto 17, Ont. • Montreal: 8525 Decarie Blvd.

DC Microvoltmeter, type GM 6020

	input I	input II
Measuring range:	100 μV (f.s.d.) – 10 V in II steps	10 mV (f.s.d.) – 1000 V in II steps
Input impedance:	1 MΩ (± 1.5%) in parallel with 20 μμF	100 MΩ (± 1.5%) in parallel with 10 μμF
Overall accuracy:	with respect to full scale ± 3%	
Pre-deflection:	< 5 μV	
Drift:	1 μV per hour after 1 hour of warming-up	

Automatic polarity indication
DC currents may be measured directly from 100 μμA (f.s.d.) up to 10 μA

L F Millivoltmeter, type GM 6012

Frequency range:	2 c/s - 1 Mc/s
Measuring range:	1 mV (f.s.d.) - 300 V in 12 steps
dB scale:	−80 dB up to +52 dB (0 dB = 1 mW into 600 Ω)
Input impedance:	4 MΩ in parallel with 20 μμF (up to 3 V); 10 MΩ in parallel with 10 μμF (in the other ranges)
Overall accuracy:	with respect to full scale ± 2.5%, 5 c/s - 100 kc/s ± 5%, 2 c/s - 1 Mc/s
Pre-deflection:	< 100 μV

HF Millivoltmeter, type GM 6014

	without pre-attenuator	with pre-attenuator
Frequency range:	1 kc/s-30 Mc/s	10 kc/s-30 Mc/s
Measuring range:	1 mV (f.s.d.) - 300 mV in 6 steps	100 mV (f.s.d.) - 30 V in 6 steps
dB scale:	−80 dB up to -8 dB	−40 dB up to +32dB
Damping at 10 kc/s:	1 MΩ	50 MΩ
1 Mc/s:	700 kΩ	10 MΩ
30 Mc/s:	50 kΩ	2 MΩ
Input capacitance:	7 μμF	2 μμF
Pre-deflection:	compensated by electrical zero setting	

Variations of the frequency characteristic:
< 5% over the whole range, with respect to the response at the frequency of the calibration voltages

Overall accuracy: ± 3% with respect to full-scale and with reference to the frequency characteristic

instruments: quality ***tools*** for industry and research

PHILIPS

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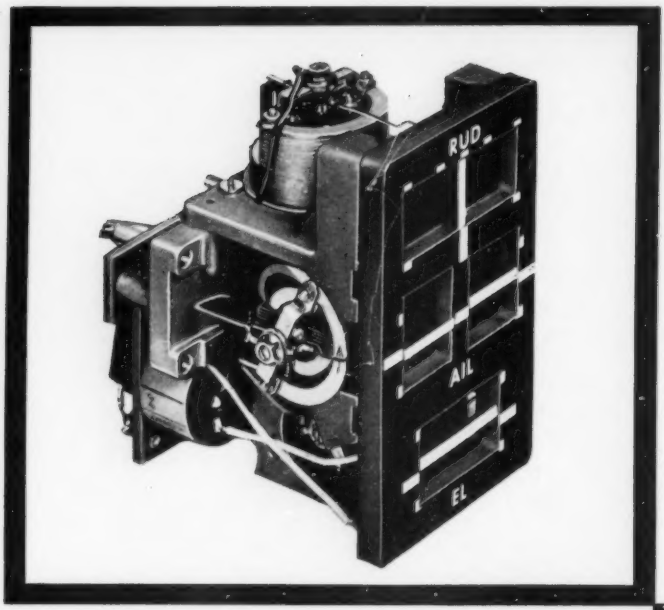
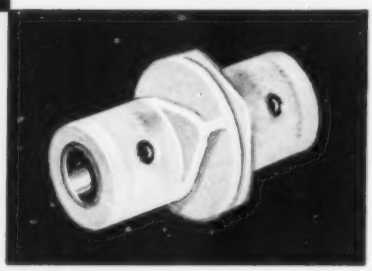
We've tackled some BIG problems...



The pilot of today's supersonic fighter aircraft — as heavy as yesterday's airliner — no longer **FEELS** the controls in the old sense. Instruments like the one at left indicate the position of the control surfaces.

The problem of squeezing the necessary four instruments — rudder, left and right aileron, and elevator — into a space only 3" x 3" x 2" was solved by the use of Bach-Simpson's core-magnet movement. Eliminating the effect of variations in the aircraft supply voltage — our biggest headache — necessitated our designing and tooling a new ratio-type movement from scratch!

...and some little ones!



By contrast, the problem of creating a flexible coupling — to eliminate binding of the long control and switch shafts in the Bach-Simpson Model 2610 Oscilloscope — seems minute! Yet in its own way, the resulting component at right also exemplifies the versatility of Bach-Simpson's unique Engineering, Tooling and Production facilities — a combination which is at **YOUR** service!

...can we help you with yours?

WRITE FOR AN APPOINTMENT WITH OUR MOBILE DISPLAY UNIT . . . AND SEE WHAT WE MEAN!

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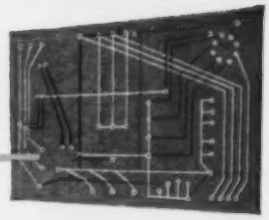
FORMICA® Laminated Plastic XXXP-36



missile circuitry must be dependable and economical, too!

Formica® XXXP-36
. . . now better than ever!

- 12# average bond strength
- 500°F solder heat resistance
- 1 million megohms IR
- Cold punch 1/16"
- Dimensional stability
- Low moisture absorption

Circuitry in the Bomarc — and many other missiles, too — is made of Formica XXXP-36. It's recognized everywhere as one of the best paper base copper clad laminates ever made, and yet it's definitely not a premium price sheet. Therefore, the valuable properties shown at left (normally found only in premium sheets) cost circuit manufacturers nothing extra.

For complete information on XXXP-36 and the other outstanding grades in the Formica copper clad line, get your copy of the new Copper Clad Technical Data Book, form 830. Write us for complete information and the names of our Formica Fabricator-Distributors. Cyanamid of Canada Limited, Laminated Products Department, St. Johns, Quebec.

FORMICA® Laminated Plastic

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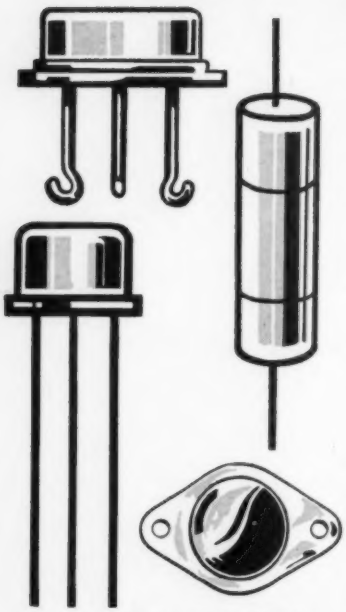
AND MORE COMING!



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SIGC	2N329A	MIL-S-19500/111 Amend. 1
Germanium Gold Bonded Diodes		
JAN	1N270	MIL-E-1/992A
JAN	1N276	MIL-E-1/1025
JAN	1N277	MIL-E-1/993A
JAN	1N281	MIL-E-1/961
PNP Germanium Transistors		
USAF	2N404	MIL-T-19500/20
SIGC	2N416	MIL-T-19500/56A
SIGC	2N417	MIL-T-19500/57A

Service	Type	Specification
NAVY	2N422	MIL-T-19500/66A
SIGC	2N425	MIL-T-19500/41A
SIGC	2N426	MIL-T-19500/42A
SIGC	2N427	MIL-T-19500/43A
SIGC	2N428	MIL-T-19500/44A
SIGC	2N464	MIL-T-19500/49B
SIGC	2N465	MIL-T-19500/50A
SIGC	2N466	MIL-T-19500/51A
SIGC	2N467	MIL-T-19500/52B
JAN	2N468	MIL-S-19500/51B
Germanium Point Contact Diodes		
JAN	1N126A	MIL-E-1/156C
JAN	1N127A	MIL-E-1/157C
JAN	1N128	MIL-E-1/158B
JAN	1N198	MIL-E-1/700

Service	Type	Specification
Diffused Junction Silicon Rectifiers		
JAN	1N253	MIL-E-1/1024A
JAN	1N254	MIL-E-1/989B
JAN	1N255	MIL-E-1/990B
JAN	1N256	MIL-E-1/991B
JAN	1N538	MIL-E-1/1084A
JAN	1N540	MIL-E-1/1085A
JAN	1N547	MIL-E-1/1083A
NAVY	1N1124A	MIL-S-19500/104
NAVY	1N1126A	MIL-S-19500/104
NAVY	1N1128A	MIL-S-19500/104
Silicon Diffused Junction Diodes		
USAF	1N645	MIL-E-1/1143
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USAF	1N649	MIL-E-1/1143

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EXCELLENCE IN ELECTRONICS

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NEW 51C ALARM CONTROL AND SUPERVISORY SYSTEM

VISUAL READOUT
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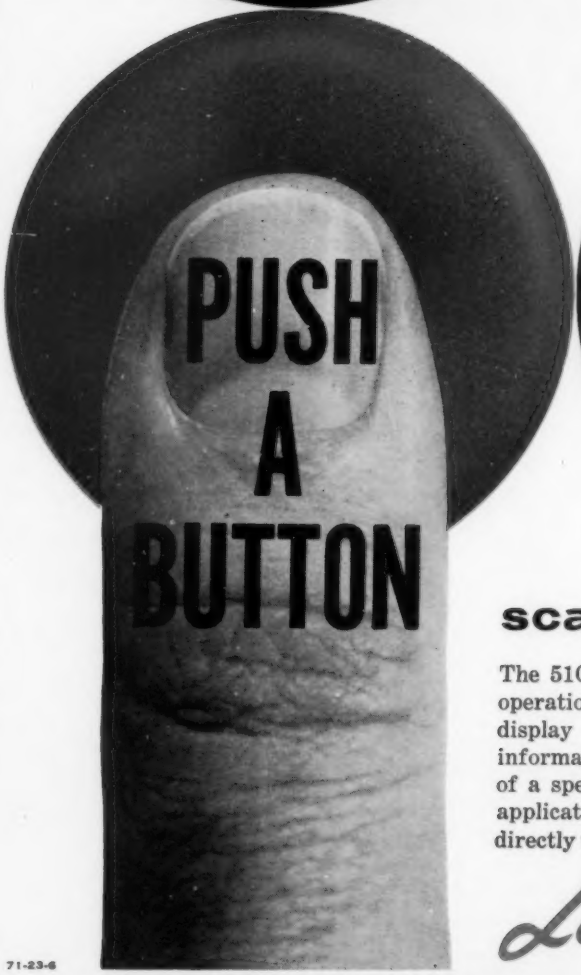
AUTOMATIC ALARM REPORTING
MANUAL INTERROGATION
VISUAL SELF TESTING
UNIT CONSTRUCTION



scan any remote station

The 51C is a new development in reporting systems – its operation is simple, certain and inexpensive. An illuminated display screen provides positive visual readout of fault information both during automatic scan or manual selection of a specific remote station. For details regarding specific applications contact your local Lenkurt Office, or write directly to:

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You want flexibility and versatility in the power supply line of highly regulated, ripple-free, temperature-current supplies, to heavy current-low voltage instruments,

NEW!

hp 723A, 500 ma output, 0 to 40 v. Transistorized, programmable remotely

hp 723A can be programmed remotely and is especially useful in systems applications where a number of measurements are made automatically at different voltages. Output voltage may be changed merely by changing the value of an external resistance, as with stepping switches for programmed tests. Low noise and ripple make the 723A particularly applicable to low level measurement. New, modular hp package combines compactness with rack-mount and bench-top versatility.

SPECIFICATIONS

Regulated Output:	0 to 40 v dc; 0 to 500 ma dc
Load Regulation:	< 0.1% or 2 mv (whichever is greater) change from 0 to 500 ma
Line Regulation:	< 0.05% or 5 mv for ± 10% line voltage change
Noise and Ripple:	< 200 μv
Remote Programming:	External resistance can control output voltage at rate of 25 ohms/volt
Output Impedance:	< 30 milliohms at 10 cps
Size:	6¼" x 5⅛" x 11"; 21 lbs.
Price:	$225.00

hp 722AR, 2 amps, 60 v output. Transistorized, easy monitoring

High regulation over complete voltage range, highly stable output. Extremely low noise and ripple insure clean measurements. High impedance remote sensing input, which connects directly to the load through wires independent from supply leads regulates the voltage at the load itself despite an IR drop in long supply leads. Separate meters measure current and voltage continuously for easy monitoring. Continuously variable control limits output current.

SPECIFICATIONS

Regulated Output:	0 to 60 v dc; 0 to 2 amps dc
Load Regulation:	< 5 mv change for 0 to 2 amps change
Line Regulation:	< 2.5 mv change for ± 10% line voltage change
Noise and Ripple:	< 250 μv
Output Impedance:	DC, < 2.5 milliohms; ac < 5 milliohms in series with 4 μh
Size:	19" x 5¼" x 12"; 34 lbs.
Price:	$525.00

hp 721A, 0 to 30 v, 150 ma output, versatile, only $145.00!

This ultra compact 4 pounds of power supply gives you easiest possible output voltage monitoring, with a large, easy-to-read meter, plus a four-step current limiter for positive overload protection. Several 721's may be operated in parallel or cascaded for extra flexibility.

SPECIFICATIONS

Regulated Output:	0 to 30 v dc; 0 to 150 ma
Load Regulation:	< 0.3% or 30 mv (whichever is greater) no load to full load
Line Regulation:	< ± 0.3% or 15 mv (whichever is greater) for ± 10% line voltage change
Noise and Ripple:	< 150 μv rms
Output Impedance:	< 0.2 ohms in series with 30 μh
Size:	7" x 4⅜" x 5¼"; 4 lbs.
Price:	$145.00

SUPPLIES BEST FITS YOUR NEEDS?

on your bench, and hp offers the world's most varied stable laboratory power supplies! From high voltage-low hp is ready to meet your requirement:

NEW!
hp 726AR, 2 amps, 45 v output. Transistorized, programmable!

This newest member of the hp transistorized power supply family provides remote programming plus the same high regulation, stable output over a wide range of line and load conditions as other instruments in the hp 720 Series. Model 726AR is especially useful for applications requiring accurate, repeatable voltages, such as component or production testing. A continuously variable current limiter protects circuits under test from accidental overload-damage. Remote sensing feature.

SPECIFICATIONS

Regulated Output:	0 to 45 v dc; 0 to 2 amps dc
Remote Programming:	External resistance can control output voltage at rate of 100 ohms/volt
Load Regulation:	< 5 mv change for 0 to 2 amps change
Line Regulation:	< 2.5 mv change for ± 10% line voltage change
Noise and Ripple:	< 250 μv
Output Impedance:	DC, < 2.5 milliohms; ac < 5 milliohms in series with 4 μh
Size:	19" x 5¼" x 12"; 34 lbs.
Price:	$500.00

PLUS THESE LAB AND FIELD-PROVED VACUUM TUBE POWER SUPPLIES
for high voltage-low current applications:

hp 711A Laboratory Power Supply	DC output 0 to 500 v, 100 ma max; ac output 6.3 v, 6 amps, or 12.6 v, 3 amps. DC regulation 0.5%.	Inexpensive, versatile high voltage, low current power supply. Metered voltage and current. hp 711A, $250.00 (cabinet); hp 711AR, $255.00 (rack mount).
hp 712B Power Supply	DC output 0 to 500 v, 200 ma max; bias supply 0 to —150 v, 5 ma max; ac output, 6.3 v, 10 amps max. Regulation 0.01% at 500 v.	High quality, high voltage supply; particularly good transient response, regulation and stability. hp 712B, $390.00 (cabinet); 712BR, $375.00 (rack mount).
hp 715A Klystron Power Supply	Beam supply —230 v to —400 v, 40 ma max; reflector supply 0 to —900 v below beam supply, 10 μa max; ac output 6.3 v, 1.3 amps. Modulation capabilities.	Klystron supply, inexpensive general purpose instrument. hp 715A, $325.00 (cabinet).

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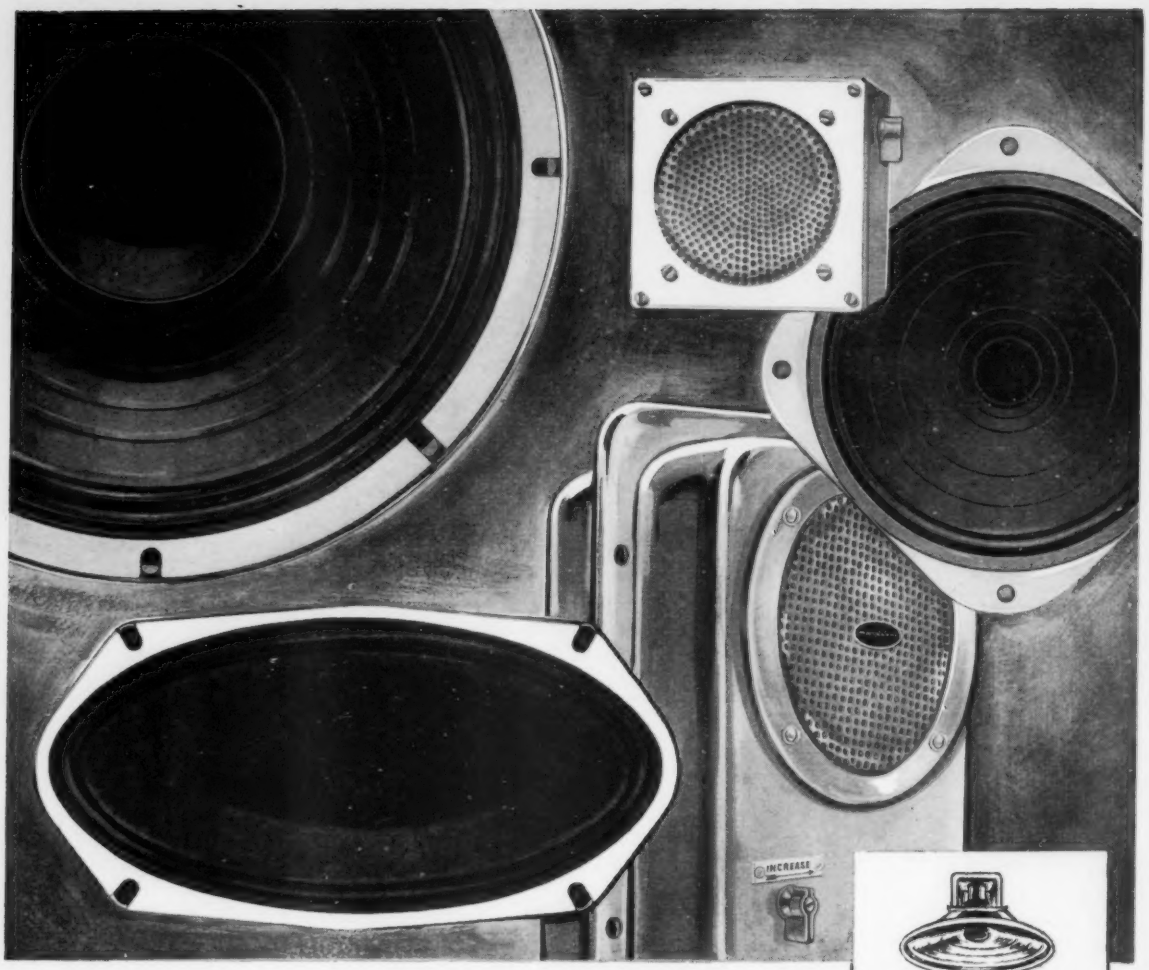
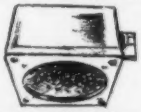


Single Speakers

Elliptical Automotive Speakers

Combination Speakers



Blast-proof Speakers and Enclosures

- **70 DIFFERENT STANDARD MODELS**
- **SPECIALS BUILT TO ORDER**

Marsland permanent magnet loudspeakers are manufactured in round, square and elliptical shape and in sizes from 2″ to 12″, with all conventional Alnico 5 magnet weights in the magnetic structure.

Standard lines provide voice coil diameters of 9/16″, 3/4″ and 1 1/4″ with impedances of 3.2 and 6 ohms. Higher impedances up to 45 ohms are available to special order.

Marsland has built millions of economical, high quality loudspeakers suited to all types of commercial applications. Stock models include: the "Imperial" line, particularly noted for faithful sound reproduction; moisture-proof models for outdoor or special inside installations; blast-proof speakers and enclosures for specialized tasks in industry and for military applications.

Detailed Information Available On Request

MARSLAND LOUDSPEAKERS

M/5

MARSLAND ENGINEERING LTD. KITCHENER, ONTARIO, CANADA

Associate Company

MARSLAND PRECISION EQUIPMENT LIMITED WATERLOO, ONTARIO

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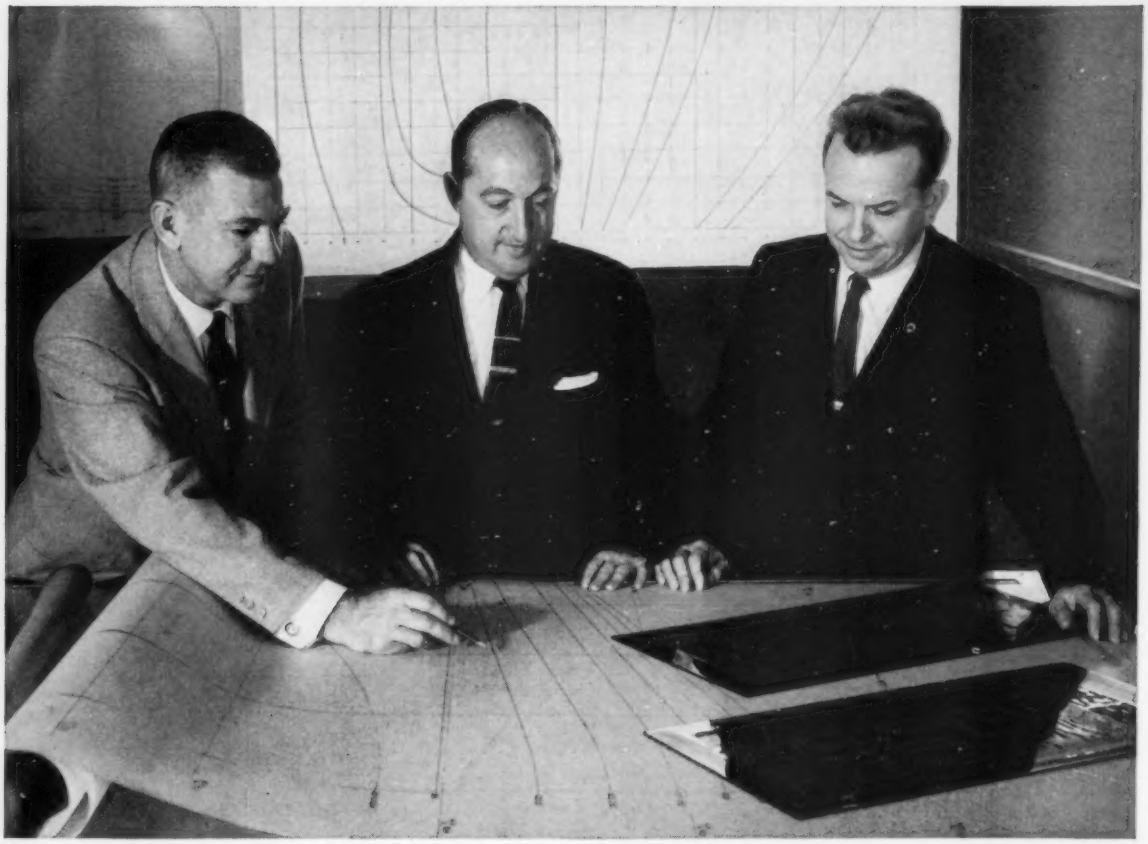
"CRONAFLEX* gives us the highest possible degree of stability in a reproduction film"

—North American Aviation, Inc., Los Angeles, California

North American Aviation, a leader in its field, uses CRONAFLEX Engineering Reproduction Films for projection and direct positive printing. In addition to its incomparable stability, CRONAFLEX has other important advantages.

One North American spokesman puts it this way, "CRONAFLEX has excellent emulsion characteristics, too. Its speed and line density are remarkably uniform from batch to batch—an extremely important factor when you consider that we make upwards of 15,000 square feet of reproductions per month."

CRONAFLEX Films can cut time and costs in *your* plant, too. Ask your Du Pont Technical Representative for information or a demonstration. Du Pont of Canada Limited, Photo Products, 85 Eglinton Avenue East, Toronto 12, Ontario.



North American Aviation's Los Angeles Division photographic experts, left to right: Clay Chapen, Supervisor of the X-ray Photo Template Lab; Buzz Holland, Manager of Photographic and Reproduction Department; Bob Mease, General Supervisor of Photographic Services, inspect a CRONAFLEX print to be used by engineers working on the B-70 triple-sonic intercontinental bomber developed by the company for the U. S. Air Force.

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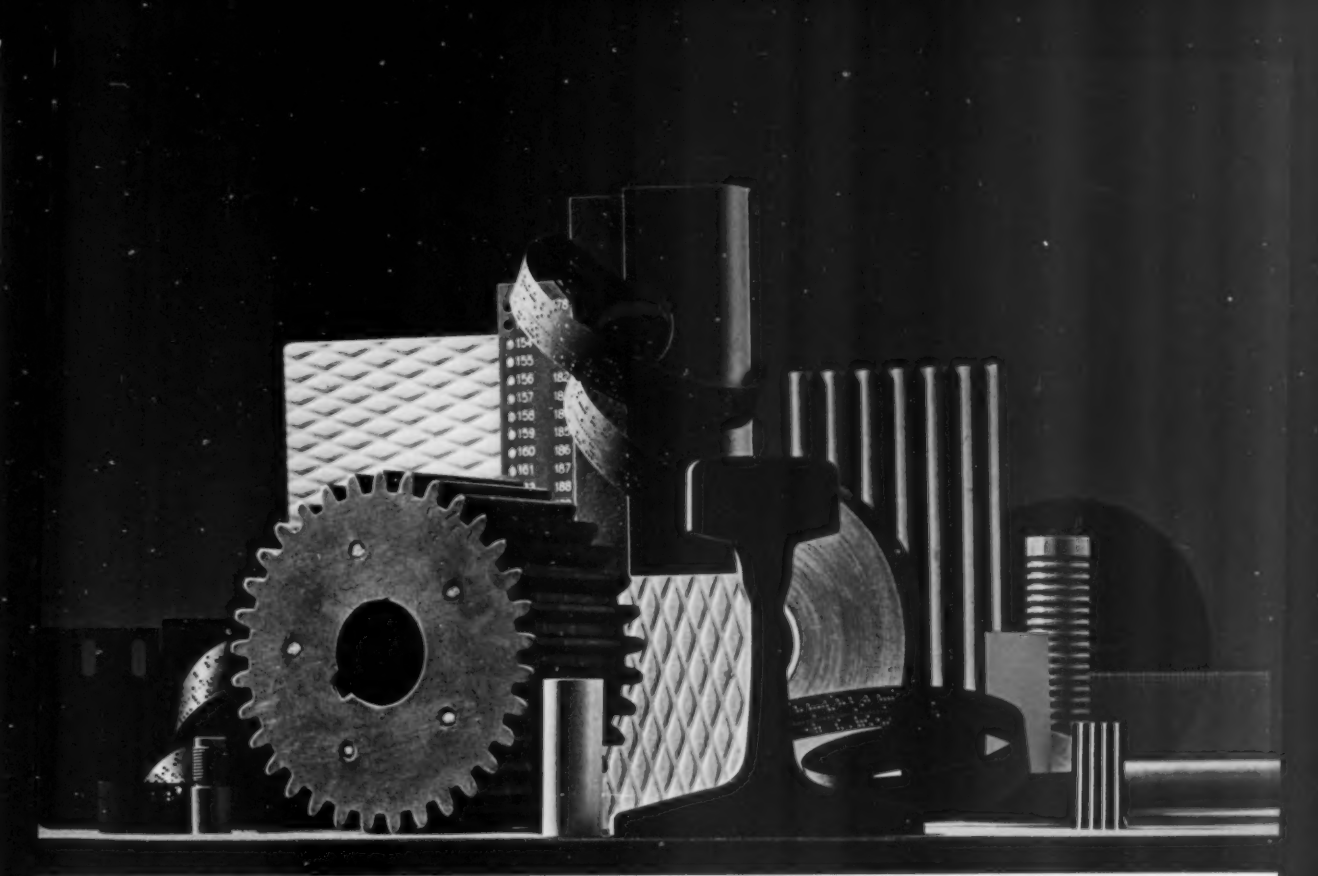

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National Vulcanized Fibre is unique. It's a tough, cellulosic plastic—not mere paper or fibreboard. Vulcanized Fibre possesses an unusual combination of mechanical, electrical and thermal properties. For example . . .

It weighs one-half as much as aluminium, yet is one of the strongest materials known per unit of weight. It's tough, durable and cushions the shock of repeated blows.

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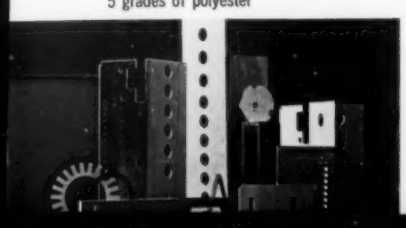

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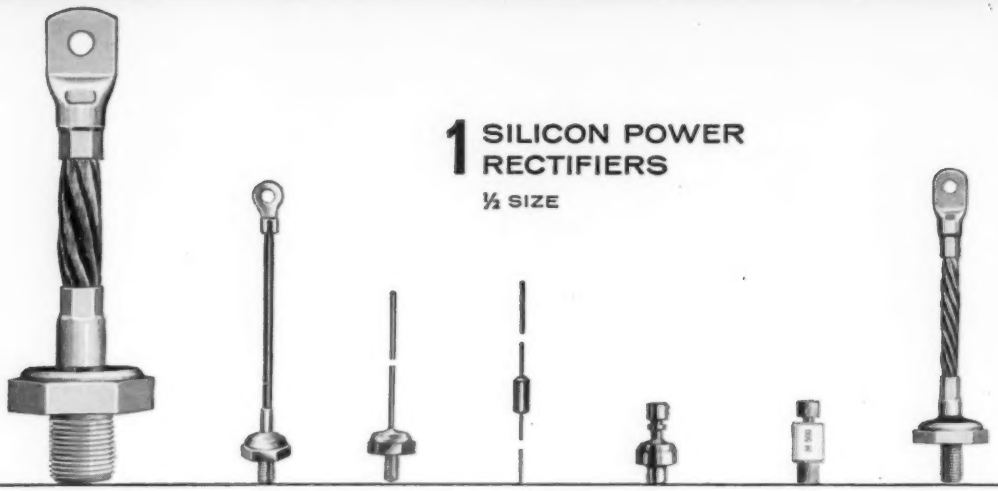
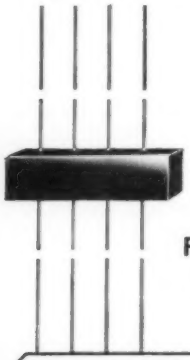


1 SILICON POWER RECTIFIERS

½ SIZE

Over 100 types for low, medium, and heavy current applications, with ratings from 150 ma to 1000 amperes; 50 to 2800 piv.



2 MODULAR SILICON RECTIFIERS

ACTUAL SIZE

For printed circuits or terminal strips—2, 3, and 4 section modules of 500 ma diodes, 100 to 600 piv.

3 SILICON VOLTAGE REGULATORS

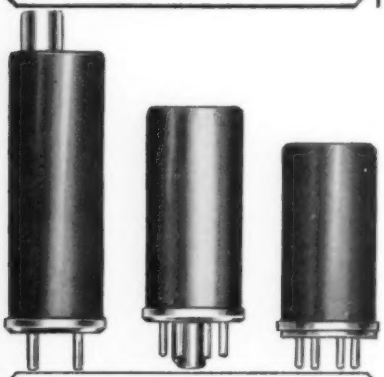
ACTUAL SIZE

Over 90 units in three power classifications—¼, 1, and 10 watts; 5.6 to 100 volts breakdown.

4 HIGH VOLTAGE SILICON CARTRIDGE RECTIFIERS

½ SIZE

Ferrule mounted and axial lead series, each in 18 different types; 600 to 16,000 piv.



5 SILICON TUBE REPLACEMENT RECTIFIERS

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Nine standard tube replacement units directly interchangeable with more than 95% of all vacuum tube rectifiers; two full-wave replacement units for Citizen's Band radios. Special types on request.

In selecting and specifying these silicon rectifiers and voltage regulators, you can depend on Tarzian experience and ingenuity in manufacturing to deliver high performance devices at realistic prices in the quantities you require, whether for testing or full production.

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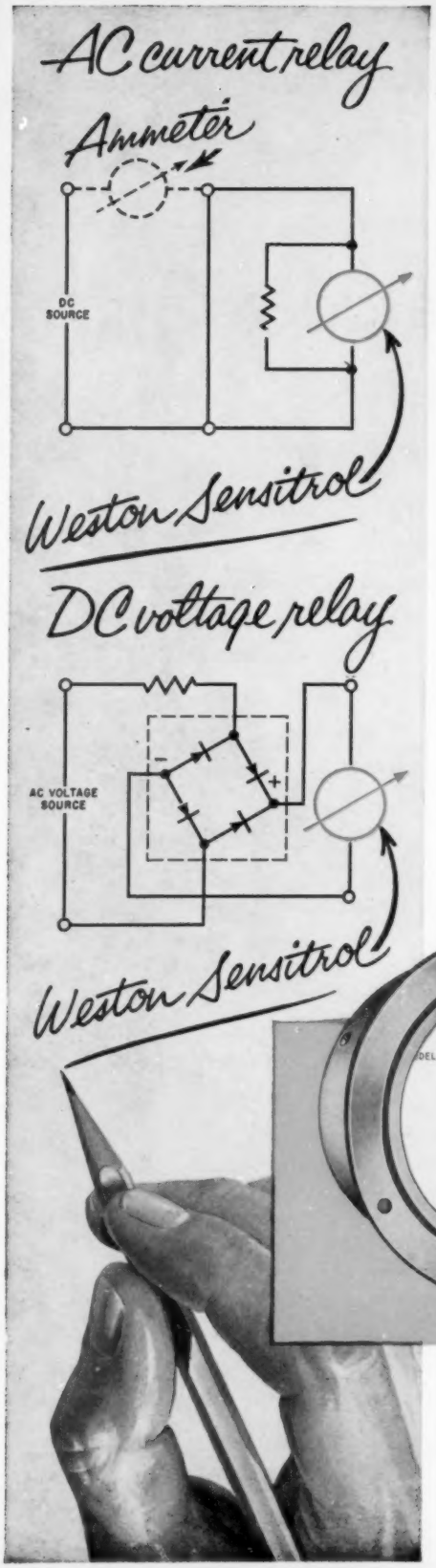

WESTON SENSITROL FOR MORE RELIABLE CONTROL

Model 1092—the most versatile, all-purpose relay...especially useful in prototype circuitry.

A truly all-purpose relay, the Weston Model 1092 Sensitrol® is serving diverse applications from commercial display to production line control. This meter-type relay with magnetic contacts is also used for continuous pulsing control and in circuits for holding variables such as temperature, voltage and light levels within critically narrow limits.

Simplicity of operation is an important factor in the growing popularity of Model 1092. A single adjustment screw controls a wide range of accurately repeatable DC values . . . from 0-50 microamperes, or comparable span of 0-100 millivolts. This instrument can be mounted on magnetic or non-magnetic panels, thanks to special Weston Cormag® self-shielded movement. It can handle up to 100 milliamperes at 120 volts AC or DC without chatter.

Many economies are possible with low-cost Model 1092 — another factor contributing to its wide application. Because it can be adjusted for an almost infinite number of settings, it eliminates the need for stocking a variety of relays in production work. And since it employs a moving coil mechanism, costly rectifiers and external converters are not required.

For more information, call or write Daystrom Limited, 1480 Dundas Highway E., Cooksville, Ontario. AT 9-3191. 5430 Ferrier Street, Montreal 9, Quebec. RE 1-3476. A subsidiary of Daystrom, Incorporated. Or any office of Northern Electric Co. Ltd.

Model 1092 Sensitrol® Relay has built-in reset mechanism operated with 120 volts AC or 48 volts DC, continuous. Reset time: 0.25 sec. Response time: approximately 0.5 sec. Size: 3.5" diameter flush case for panel mounting.

DAYSTROM LIMITED

Daystom-Weston Instruments are now
MADE IN CANADA to Canadian Standards.

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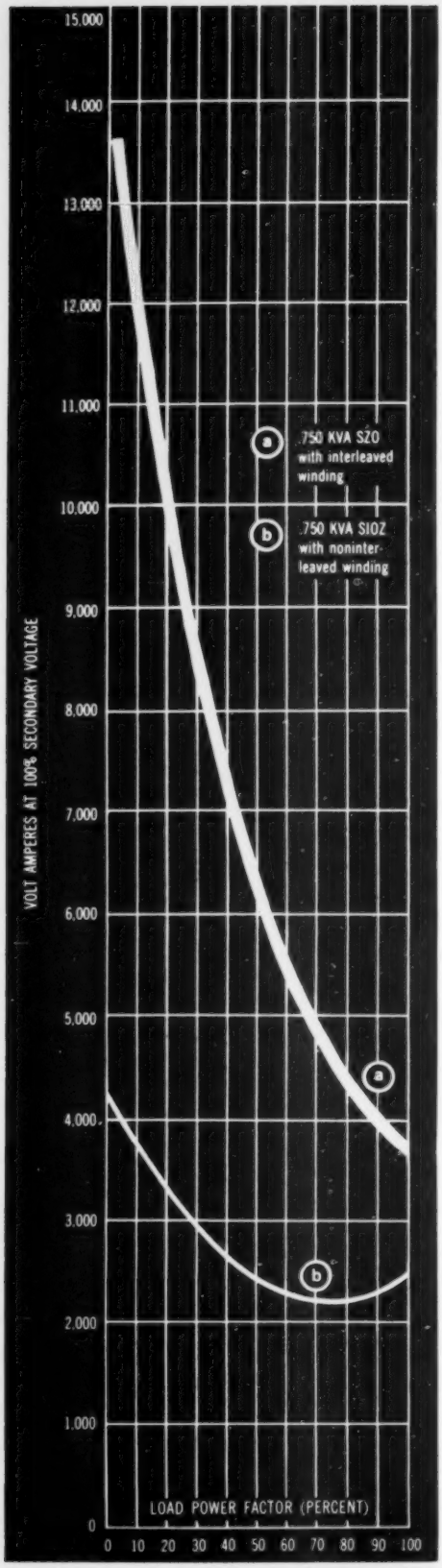
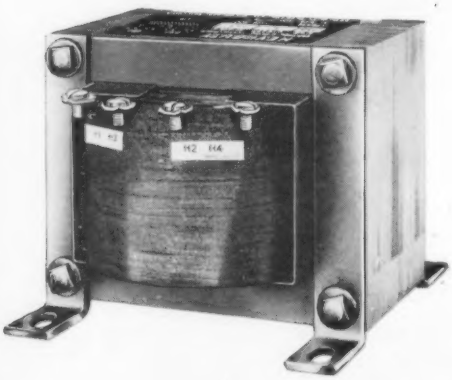


New **HEVI-DUTY** *control circuit transformer gives up to 150% greater inrush current capacity . . .*

CUTS COSTS . . . SAVES PANEL SPACE

Interleaved windings are the secret of the high inrush current capacity of these new Hevi-Duty Type SZO Transformers. The drop below rated voltage is only 5% at 1,000% inrush current. Such performance means you can specify transformer size according to sealed volt amperes in most cases . . . use a smaller, less costly transformer . . . cut panel space requirements by as much as 20%.

Ask for the new Hevi-Duty Type SZO Control Circuit Transformer for .050 to 5-kva installations. Call your nearest Hevi-Duty representative, or write for Bulletin Number 300.



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Aviation Electric Limited serves Canadian industry in five broad fields: Aviation, Industrial, Marine, Electronics, Hospital and Medical. Operating from one of the continent's most modern plants, AEL in these five categories offers industry specialized services that are second to no other — anywhere !

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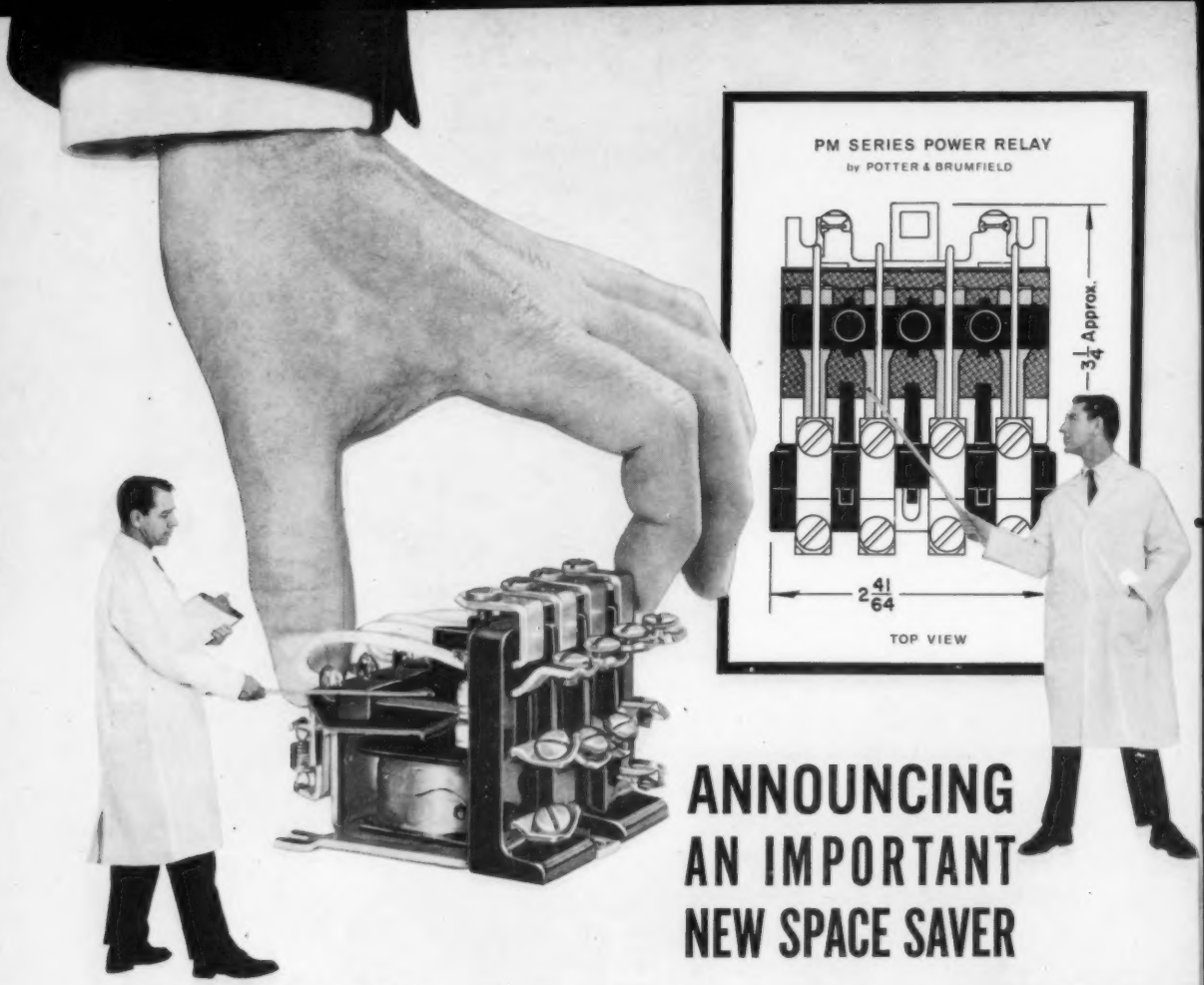


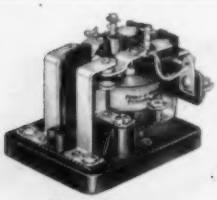
ANNOUNCING AN IMPORTANT NEW SPACE SAVER

P&B compact 4PDT power relay switches one H.P. per moveable arm

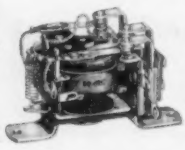
Save panel space! This new 4-pole relay is only 3/16" wider than our PR Series, America's most popular 2-pole power relay! Yet, it is engineered for reliable heavy-duty switching . . . and you can confidently expect 10 million mechanical operations.

PM Series relays are rated at 16 amperes (or 1 H.P.) at 115 volts, 50/60 cycles resistive . . . and special relays can be supplied for loads up to 25 amperes, at 220 volts, 50/60 cycles resistive. Heavy screw terminals are arranged for fast, easy hook up. An adapter plate is available for mounting PM relays in the same location used for 2-pole relays.

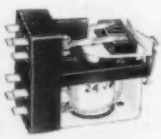
For full information, write today or call your nearest P&B representative.



PR Series



MR Series



AB Series

A whole family of power relays for a wide range of applications carry the P&B symbol of quality. Call P&B first for all your power relay requirements.

PM ENGINEERING DATA

GENERAL:

Description: Heavy-duty AC power relay.
Insulating Material: Molded phenolic.
Insulation Resistance: 100 megohms minimum.
Mechanical Life: 10 million operations minimum.
Contact Life: 100,000 operations minimum at rated load.
Breakdown Voltage: 2,000 volts rms minimum between all elements and ground.
Ambient Temperature: −55°C to +55°C.
Weight: Approximately 14 ozs.
Pull-In: 78% of nominal voltage.
Terminals: Heavy-duty screw type with No. 8-32 BH screw.

CONTACTS:

Arrangements: 4PDT or 4PST—normally open.
Material: ¼" dia. silver-cadmium-oxide.
Rating: 16 amps @ 115 volts, 50/60 cps resistive.
8 amps @ 220 volts, 50/60 cps resistive.
1 H.P. per moveable, 115 or 220 volts AC single phase.
25 amps @ 220 volts, 50/60 cps resistive available on special order.

COILS:

Voltage: 6 to 230 volts AC 50/60 cycles.
Power: 14 volt-amps average at nominal voltage.
Duty: Continuous.

P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONICS PARTS DISTRIBUTORS

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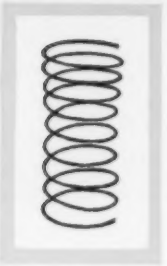

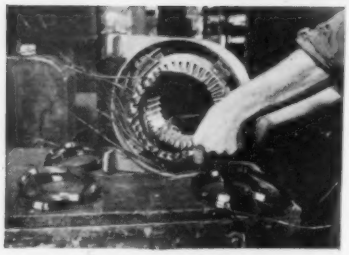

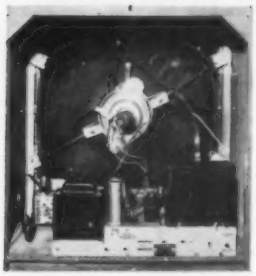

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Federal's continuing research program also develops new packaging to improve production methods and to help lower your downtime.

Federal engineering and production specialists are available to assist with your individual manufacturing problems and to specify the right Federal product to meet your requirements. Write today for further details.

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. . . and 200 miles away a telephone rings!

Eight hours ago, an expanse of barren mountainous country made communication impossible. Tonight, 60 telephone channels and teletype span the wilderness.

Transportable MICROSCATTER is a super high frequency radio system for long-range communication. Developed by Canadian Westinghouse, MICROSCATTER beams signals high above the earth sending two-way voice and teletype messages up to 200 miles over land and water . . . *without* costly relay stations.

The compact MICROSCATTER radio system fits in a standard 30 ft. truck trailer. Now, whenever men and equipment move, MICROSCATTER moves right along with them. It is particularly suited to military and government projects in remote locations. Units designed for self-contained field operations are set down by helicopter.

A Westinghouse communications specialist will be pleased to explain fully the MICROSCATTER operation and relate it to your problem. Contact your nearest Westinghouse office, or write to Canadian Westinghouse Company Limited, Electronics Division, Hamilton, Canada. YOU CAN BE *SURE* . . . IF IT'S WESTINGHOUSE.

MICROSCATTER APPLICATIONS

COMMERCIAL	MILITARY
Fixed Station —120 telephone channels	Wide Band —radar
—television and sound	—data
	—120 telephone channels
Transportable—60 telephone channels	Tactical and —60 voice channels
—teletype	Transportable—teletype
	—data

FEATURES

- Frequency—4400-5000 mc
- Antennas —10 to 28 ft. diameter
- Power—2 KW
- Range—100 to 200 miles

CANADIAN
Westinghouse Microscatter

60-A-745

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PUBLISHED IN JUNE 1961 BY CANADIAN ELECTRONICS ENGINEERING

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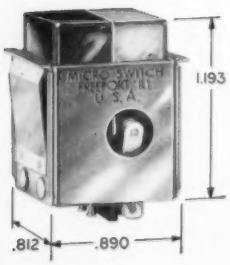
FULL COMMAND IN ONE CUBIC INCH!



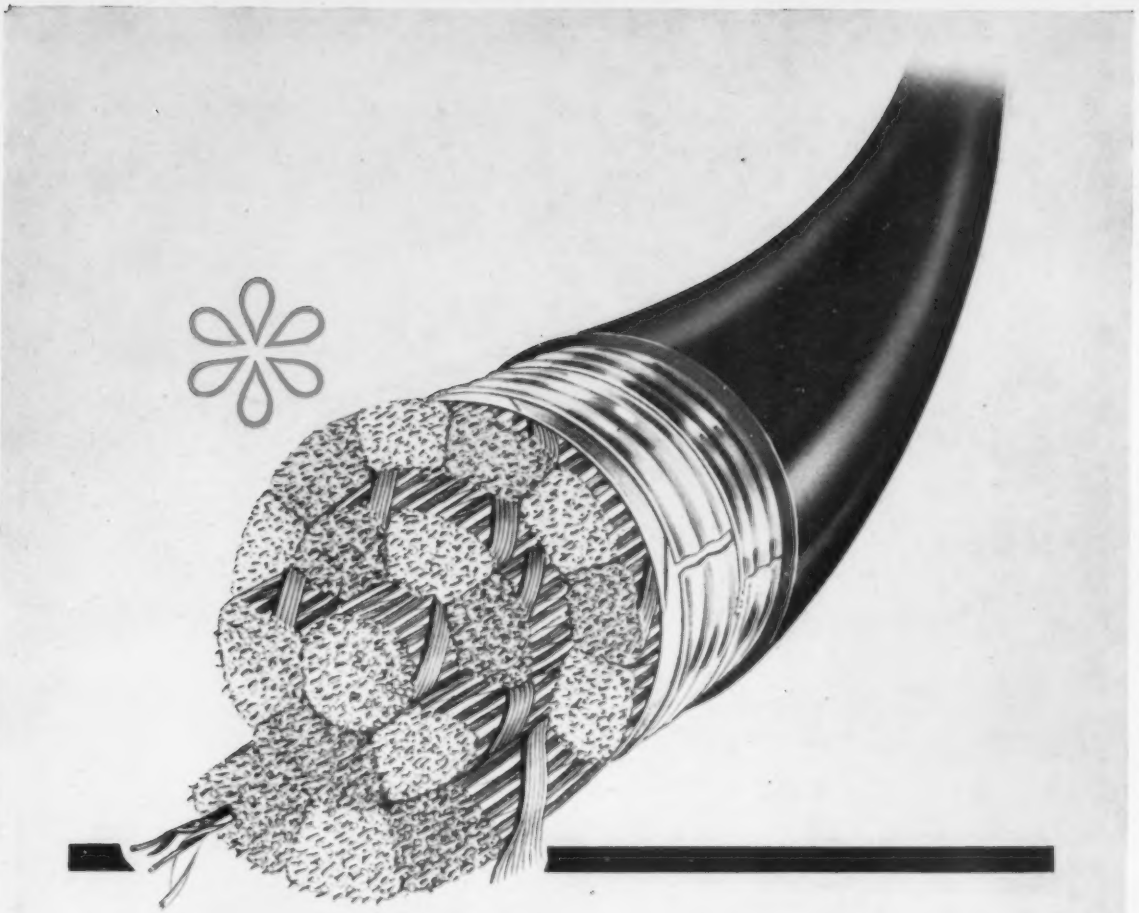
NEW MINIATURIZED LIGHTED PUSH-BUTTON SWITCHES SAVE PANEL SPACE

The display screen, mounting flanges and two single-pole double-throw basic switches are all integral components, permanently assembled to make a mechanically strong unit built for long life. Fifteen display screen color combinations are available, obtained by use of split screen. A separate miniature lamp illuminates each half of the screen. These lamps are designed for infinite service life. "302PB" Series switches conform to the applicable requirements of MIL-S-6743, MIL-S-6744 and MIL-E-5272A. For Data Sheet 182, call your nearest Honeywell office or write Honeywell Controls Limited, *Precision Components Division*, Toronto 17, Ontario.

Honeywell

MICRO SWITCH Precision Switches

For further information mark No. 37 on Readers' Service Card



3030 commuters ride this 3" subway

The Phillips STALPETH cable, shown above, is available with up to 3030 pairs of No. 26 gauge, paper insulated conductors within an approximate diameter of 3 inches. STALPETH cable weighs only half as much as PILC and costs less in all sizes. And soldered steel tape provides completely moisture proof construction. ● Another Phillips cable, ALPETH, is available with up to 400 pairs of plastic insulated conductors, colour coded for simplified installation. Flat or corrugated aluminum shielding provides maximum protection and flexibility. ALPETH is light in weight, easy to joint and terminate, and longer runs reduce the number of joints. ● Other Phillips cables stocked and sold by AUTOMATIC ELECTRIC include Urban Distribution (16 pair only), Suburban Distribution (6, 11 or 16 pairs) and Rural Distribution (up to 18 pairs). For full information on Phillips cables and a complete line of pole hardware available from AUTOMATIC ELECTRIC write Automatic Electric Sales (Canada) Limited, 185 Bartley Drive, Toronto 16, Ontario. Branches across Canada.

*STALPETH Cable manufactured by
PHILLIPS ELECTRICAL COMPANY LIMITED

AUTOMATIC ELECTRIC

Subsidiary of

GENERAL TELEPHONE & ELECTRONICS

GENERAL SYSTEM

For further information mark No. 12 on Readers' Service Card

Here it is... the sleek new

STARLITE* BY AUTOMATIC ELECTRIC

The new, luminescent STARLITE by Automatic Electric offers telephone companies a useful source of additional revenues. Designed and developed after exhaustive research, and manufactured in Canada at our Lethbridge plant, it provides all the modern features and benefits your subscribers have been asking for.

CSA approved • Can be used as a main station with the addition of a miniature ringer box • PANELESCENT® dial light provides long life, needs only very infrequent maintenance...can be readily adjusted to any desired illumination or switched off completely • Smart modern design • Rubberized base and soft pull cord minimize slipping • Available in six sparkling colours • And it's *less than half the size* of a regular phone. Automatic Electric Sales (Canada) Limited, —185 Bartley Drive, Toronto 16, Ontario. Branches across Canada.

*T.M. Reg'd.

AUTOMATIC ELECTRIC
Subsidiary of
GENERAL TELEPHONE & ELECTRONICS

For further information mark No. 13 on Readers' Service Card

Radio, tube importers distort the facts

H. C. MacKendrick, general manager of the Canadian Importers and Traders Association (CITA), has replied to EIA's brief on radio and tube imports (see page 5) with a statement in the association's news-sheet "The Importers' Bulletin" entitled "The facts concerning the electronics industry."

It refers to EIA's use of terms such as "looting," "false fair-market values" and "profiteering importers," and suggests that "these extreme and injurious charges are not substantiated by the facts." Yet Mr. MacKendrick resorts to twisting the facts, using half-truths, and applying the familiar trick of omission to "prove" his case!

Let's examine his arguments and see whether they stand up.

CITA says: "If we examine the import statistics of radio and television tubes for the past three years we find that the total dollar values of imports from all countries has remained fairly constant. However, we find that the increase in imports from Japan each year is approximately equal to the decrease in imports from the U. S. A. What is happening is that there is a shift in trade from the U. S. A. to Japan. From the point of view of our balance of trade this is good, since we incur a large deficit in trade annually with the U. S. A. while we have a surplus trading balance with Japan."

It is true that the total dollar value of tube imports has remained fairly constant over this period, but to suggest that we are simply buying now from Japan what we used to buy from the U. S. A. is absurd. The bulk of our imports from the U. S. A. are specialized types not made in Canada. The reduction of $1,140,743 in value represents a reduction in quantity of 1,617,554 units, the unit value having increased from $1.07 to $1.19.

On the other hand, imports from Japan have comprised the very types that the Canadian tube industry is tooled-up to manufacture. The increase in value of $1,159,714 represents a quantity increase of 3,735,044 units, the unit value having remained constant at the declared figure of 31 cents. And the increase would have been even more significant if the embargo negotiated with the Japanese last October had not been imposed.

To compare these two sets of figures is insupportable. It is equally improper for the importers to take the figures for shipments of made-in-Canada radio receivers in 1955 and 1960 (621,957 and 696,419 units respectively) as refutation of EIA's case regarding this product. Particularly when the total Canadian market for radios has more than doubled in the same period from 651,731 to 1,423,794 units.

We would be pleased to offer space in the editorial pages of CEE to any of the importers to present their case, but the presentation must at least be statistically valid!

THE EDITOR

Canadian Electronics Engineering's guide to the...

International Instrument — Automation Conference & Exhibit

Toronto, June 5-6-7-8

A comprehensive program of instrumentation progress and trends will be featured at the International Instrument - Automation Conference & Exhibit, Toronto, June 6-8, 1951, under Instrument Society of America sponsorship. The Royal York Hotel will be the conference site for forums on measurement, data processing and automatic control. The exhibit, at the Queen Elizabeth Building, Exhibition Park, will be a complementary focal point where 6,000 technical and management personnel are expected to assemble to examine the equipment of over 150 instrument manufacturers.

The following information on technical sessions, exhibits and products will provide a preliminary key to what you can see and hear at the show. Some additions and changes can be expected, but they will be minor ones.

Management day

Preceding the conference and exhibit, a one-day symposium on "Industrial Instrumentation—the Impact of Computers" will be held Monday, June 5. The symposium is intended to serve management rather than instrument specialists and will outline the development of instruments and controls as dictated by industrial requirements. The role of computers in modern industry will be given prominence.

Ladies' activities

Highlight of the ladies' program will be a matinee performance of Flower Drum Song at the O'Keefe Centre for the Performing Arts, a $12,000,000 theatre modelled after the Royal Festival Hall in London. The ladies will also enjoy a luncheon in Eaton's Georgian Room, a sightseeing bus tour of Toronto, and a stop-over for tea at The Old Mill. Mrs. Edna McLean of Canadian Westinghouse Co. Ltd. is in charge of Ladies' Activities.

Transportation

There will be free bus transportation for delegates between the Royal York Hotel and the Queen Elizabeth Building during the hours the exhibition is open. They are:

Tues., June 6—1 p.m. to 9 p.m.
Wed., June 7—1 p.m. to 9 p.m.
Thurs., June 8—10 a.m. to 6 p.m.

Social events

During the conference there will be two main social events for registered delegates.

The International Cocktail Hour will be held Monday, June 5 from 5 to 7 p.m. in the Canadian Room, Royal York Hotel. Admission is by your registration card; refreshments will be paid for as ordered.

The main social event will be held Wednesday, June 7, at the Royal York Hotel. Entertainment and dancing will commence at 8 p.m. Tickets may be purchased when registering.

Film feature

During the conference, films on instrumentation will be shown continuously at the Queen Elizabeth Building. Appropriate films are being obtained from manufacturers.

Technical program and abstracts

Tuesday AM June 6

CHEMICAL AND PETROLEUM INSTRUMENTATION SESSIONS I AND II (Tuesday morning and afternoon).

Instrumentation of a modern refinery waste disposal system.

K. G. Seabright, Technical Director, Cities Service Refining (Canada) Ltd., Oakville, Ont.

The various wastes from a modern petroleum refinery and the instrument controls of the disposal system are described. Particular reference is made to the purification of the waste water.

Proving meters in liquid service.

Ray Pfrehm, Supervising Engineer in charge of Research and Development, Humble Pipeline Co., Houston, Texas.

A discussion of problems involved with proving in liquid service along with the story of the development of the pipe prover.

Controllability of processes as affected by the controller circuit.

Nathaniel B. Nichols, Vice President and Chemical Engineer, and **Richard N. Pond,** Application Engineering Research, Taylor Instrument Companies, Rochester, N.Y.

This paper discusses the effect of controller circuit design on Ziegler-Nichols settings as well as non-linear performance. It points out that there is more to good process control considerations than just modes of control.

Analysis of process control systems by means of an analog computer.

V. J. Bakanowski, Principal Computation Engineer, Du Pont of Canada, Montreal.

This paper provides some examples taken from actual application of an analog computer in studies of process and instrument dynamics.

The Canadian Standards Association Testing Laboratories and safety aspects of electronic instruments for the petro-chemical industry.

John A. Bossert, engineer, Toronto.

A brief outline of the operating procedures and policies of the Laboratories is given, followed by more specific information regarding Canadian requirements for electronic instruments intended for use in oil refineries, fields and pumping stations.

Process management by control computers: tactics and strategy.

Harry R. Karp, Managing Editor, Control Engineering, New York.

This paper reviews alternatives for process improvement by plant modification and by control equipment. It outlines two basic control approaches: systems for carrying out tactical missions (correction for short term, simple disturbances); and for carrying out strategic missions (optimizing according to long term, complex disturbances). It describes the role of control computers in effecting these missions including other associated instruments. It also discusses some of the existing control computer installations.

MARINE SCIENCES INSTRUMENTATION SESSIONS I AND II (Tuesday morning and afternoon)

Equipment for observing the magnetic component of the natural electromagnetic background in the frequency range 0.01 to 30 cps.

Dr. W. N. English, D. J. Evans, J. E. Lokken, J. A. Shand and C. S. Wright, Defence Research Board, Pacific Naval Laboratory, Esquimalt, B.C.

The instruments designed and constructed for measuring the geomagnetic background between 0.01 and 30 cps, which have great dynamic range in frequency and time, are described. Large effective area detector loops combined with high gain, very low noise amplifiers form an effective receiving system. Methods of absolute calibration are discussed.

Oceanographic instrumentation buoy designed for unattended operation.

L. A. Schlagel, Hytech Corp., Inglewood, Calif.

The factors which must be considered in the design of an oceanographic instrumentation buoy are discussed in detail. A specific buoy and power supply design are described which will operate unattended for two months between servicing.

Calibration of hydrophones under high hydrostatic pressures.

Garfield W. McMahon, Defence Scientific Service Officer, Defence Research Board, Naval Research Establishment, Dartmouth, N.S.

Two calibration systems for the measurement of hydrophone sensitivity under high hydrostatic pressures are described. The relative advantages and disadvantages of the two systems are discussed.

Modern approaches to water level recording in Canada.

G. C. Dohler, Officer-in-Charge, Gauging & Publications, Canadian Hydrographic Service, Ottawa.

In addition to the traditional mechanical float-operated gauges for recording tides and water levels, the Canadian Hydrographic Service now uses recorders with underwater transducers, either electrical or pneumatic, and also a variety of telemetering gauges for distant recording.

Techniques of current measurement in Canadian Waters.

C. J. Langford, Technical Officer, Canadian Hydrographic Service, Ottawa.

The recent history of current surveying in Canada is outlined, and the instruments and techniques used in measuring tidal streams and currents are described. The paper also discusses the problems met within both Arctic and Atlantic waters and the developments initiated to improve methods of both metering and calculation of these data.

MANAGEMENT SESSION

Impact of instrumentation on management.

Rene Simard, Chief Process Engineer, Imperial Oil Ltd., Sarnia, Ont.

The need for automation has caused an extensive review of manpower. Management decisions are required on size, qualifications, training and organization of instrument groups.

A chemical systems engineering training course in a petrochemical company.

Chen-Jung Huang, Associate Professor of Chemical Engineering, **T. Q. Eliot and D. R. Longmire,** University of Houston, Houston, Texas.

The paper concerns actual experience regarding organization, purpose, objectives and accomplishments of a chemical systems engineering training course at a medium-sized petrochemical company. By this paper, the authors wish to have lively discussion

Technical program

with the audience on the pros and cons of intracompany training of systems engineers.

POWER INSTRUMENTATION

Design aspects of the instrumentation and control systems — Lakeview generating station.

J. T. Norris, Hydro-Electric Power Commission of Ontario, Toronto.

This paper will describe the Lakeview generating station. At the present time this station is claimed to be the largest thermal central station in the world under construction. It will have six 300 megawatt units. The speaker will talk on the philosophy of instrumentation and control adopted in the design of this station.

Electric control systems for central stations.

E. E. Swanson Jr., Bailey Meter Co., Wickliffe, Ohio.

This paper will describe a Bailey Meter Co. system which has not been employed in central stations in Canada up to the present, and is comparatively rare in the United States.

The control and instrumentation of the Douglas Point Nuclear Power Plant.

Ernest Siddall, Atomic Energy of Canada Ltd.

This is a talk on the special instrumentation and control features of the Douglas Point plant. The reactor for this station, unlike British and U.S. power reactors, is heavy water moderated and requires a different approach to its instrumentation and control.

Tuesday PM June 6

CHEMICAL AND PETROLEUM INSTRUMENTATION SESSION II

(See Session I above for details of papers.)

MARINE SCIENCES INSTRUMENTATION SESSION II

(See Session I above for details of papers.)

Wednesday AM June 7

MEASUREMENT & CONTROL INSTRUMENTATION

A new approach to electric actuation of control valves.

Name of author and summary not available at time of publication.

Theory and operation of a film tensiometer and application to study of a continuous process.

Name of author and summary not available at time of publication.

FEEDBACK CONTROL SYSTEMS

A systems approach to electronic industrial process control.

H. H. Koppel, Manager, Electrical Section, Research and Development Dept., Bailey Meter Co., Cleveland.

The complexity and critical control requirements of modern industrial processes make it desirable to consider control of various process loops on a system-wide basis. Process controllers discussed are considered not as separate single element controllers, but as computing devices designed to fulfill specific mathematical functions.

Process optimization by combining the model and experimental approaches.

Kan Chen and Richard O. Decker, Advisory Engineers, Westinghouse Electric Corp., Pittsburgh.

The relative merits of the model approach and the experimental approach to process optimization are discussed. An optimization method combining these two approaches is described, with examples, so that the merits of both approaches are retained.

ANALYSIS INSTRUMENTATION

Names of authors and summaries not available at time of publication.

Principles and operation of a dual frequency moisture gauge.

The use of a silver duo electrode made of uranium, glass and tungsten for electrometric analysis of traces of minerals.

Prediction of separations and other specifications of gas chromatic columns.

A simple meter for determining moisture in coal.

Open path infrared analyzers today.

Thursday AM June 8

DATA HANDLING AND COMPUTATION SESSIONS I AND II. (Thursday morning and afternoon)

A spectrophotometer digital output system.

Daniel Hampel, Project Engineer, RCA Service Co., Camden, N.J.

Operating experience and justification of purchase of a solid state data logger.

Oddis J. Baker and H. F. Dunlop, Union Carbide Nuclear Co., Oak Ridge, Tenn.

The building block approach to digital systems.

J. V. Werme, C. H. Terrey and M. Maczuzak, Bailey Meter Co. Ltd., Toronto and Cleveland.

Integration of computer control with the chemical process.

J. P. Smith, Senior Application Engineer, General Electric Co., Schenectady.

Temperature monitoring system for NPD-2 nuclear power plant.

Part I: W. W. Cliffe, Instrumentation and Process Control Engineer, Canadian General Electric Co. Ltd., Civilian Atomic Power Dept., Peterborough.

Part II: T. K. Cranston, Chief Engineer, Automation and Data Systems, Fischer & Porter (Canada) Ltd., Toronto.

STRAIN GAUGE INSTRUMENTATION SESSIONS I AND II (Thursday morning and afternoon)

Development of flame sprayed sensors.

Stanley W. Leszynski, Research Specialist, Aero-Space Div., Boeing Airplane Co., Seattle.

This paper describes adapting the flame spraying technique to the fabrication and attachment of various types of sensing devices. The use of this method for the development of reliable strain and thermo sensors under controlled and refined application and conditions is discussed. Test results indicating accuracies of $\pm 3\%$ at 1,000 deg. F. are described.

Stress determination with Bakelite-backed strain gauges under transient heating conditions.

Mintauts F. Andreika, Research Engineer, Aero-Space Div., Boeing Airplane Co., Seattle.

A method of measuring stresses with bonded strain gauges can be extended to include stress determination under transient heating conditions if the temperature effect on both the transducer and the test specimen are carefully considered and necessary correction applied to the indicated results. This paper presents the basic considerations for practical determina-

tion of obtaining the necessary data, and the calculation of transient stresses using steady-state calibrated data.

Preparation of strain gauges for bonding to ice.

Don B. Clark, Acting Director of the Physics and Electronics Div., U.S. Naval Civil Engineering Laboratory, Port Hueneme, Calif.

This paper describes techniques for waterproofing and modifying ordinary paper-backed strain gauges so they can be frozen to ice surfaces for strain measurements.

Measuring torque and tension in oil field drill pipe with strain gauges.

James T. Dean, Research Engineer, and Wilton Gravley, Senior Research Engineer, Secony-Mobil Oil Company's Field Research Laboratory.

This paper describes the construction and assembly of a strain gauge transducer fabricated to measure the torque and tension in drill pipe on an oil field drilling rig. The transducer rotates in the drill string; in an atmosphere of drilling mud, air, or natural gas. The signals are transmitted from the transducer to the recorders through a large set of slip rings mounted on the rotating drill stem.

Analysis of low level output signals from complex structural deformation.

Cloyce E. Matheny, Chief, Flight Data Analysis, McDonnell Aircraft Corp., St. Louis, Missouri.

This paper discusses the set-up requirements, both for calibration and in-flight recordings, and the techniques of analysis of the low level output signals. A comparison is drawn between the improvements made using the low level PDM system above that of the oscillographic method.

Method of determining stress in loaded steel billet tiebacks.

Thomas D. Dismuke, Engineer, Bethlehem Steel Co., Sparrows Point, Maryland.

This paper describes a method of determining the stress in loaded steel billets that are used as tiebacks for steel sheet pile bulkheads. SR-4 strain gauges were used to measure localized strain increases induced by drilling a hole through a billet.

Large scale field application of strain gauges.

John Leak, Group Leader, Canadair Ltd., Montreal.

This paper will describe techniques found most suitable and economical for the application of large numbers of strain gauges under field conditions, using semi-skilled labor. The paper refers to the aircraft industry, but the techniques may be applied to other industries.

AUTOMOTIVE INSTRUMENTATION

An over-all look at automobile road test instrumentation.

Paul C. Skeels, Head, Experimental Engineering Dept., General Motors Proving Grounds, Milford, Mich.

A presentation of current methods and instrumentation used in testing automobiles, primarily on the Proving Ground at Milford. It will describe the responsibilities of automotive test instrumentation groups and will discuss some of the more unusual problems.

Automotive applications of strain gauge instrumentation.

Milton Lebow, formerly Associate Professor of Engineering Mechanics, Wayne State University.

This paper will present a number of applications of strain gauge instrumentation to vehicle testing. After an introductory discussion of strain gauge transducers, various specialized transducers for the measurement of force, torque and pressure will be described together with some case histories.

Road test simulation in dynamometer test cells.

Roy F. Knudsen, Assistant Engineer in Charge of Instrumentation, General Motors Engineering Staff, and **Frank M. Ward,** Sr. Instrumentation Technician, General Motors Research Laboratories.

After a review of test cell dynamometer facilities, and a discussion of traditional steady state testing, this paper discusses the techniques of using the test cell as a road simulator and describes several methods for programming specific automobile tests on a dynamometer.

Thursday PM June 8

DATA HANDLING & COMPUTATION SESSION II

(See Session I above for details of papers.)

STRAIN GAUGE INSTRUMENTATION SESSION II

(See Session I above for details of papers.)

What the exhibitors are showing

- **Name**
- **People**
- **Principals**
- **Products**

*** indicates ISA member;**

† indicates New Product

For additional news of products, see page 61

Ahearn & Soper Co. Ltd., Toronto.

American Standard Controls Division, Detroit.
Ralph Foster, Willis Stafford, Robert Jones.
Electrosyn pressure or temperature measuring system; Rochester dial thermometers and high pressure gauges.

American Superior Electric Co. Ltd., Toronto.
Joseph S. Louden, Peter R. James, Ross Gilbreath, Ward Murphy.
A new mechanical "muscle" that receives and carries out instructions from an electronic "brain" will be demonstrated. The device will thread a needle and find the way out of a maze. **The "muscle"** is a new Slo-Syn synchronous motor which can start, stop or reverse itself up to 400 times per second. The memory of the electronic "brain" is stored on a tape which transmits commands through an electronic translator† circuit to the motor. The new system is a step forward in automation of machine tool control, etc.

Auto Hot-Stick Rentals, Inc., Compton, Calif.

Automatic Electric Sales (Canada) Ltd., Toronto.
A. C. Stewart, J. D. Breedon, L. A. Haizelden, B. H. Martin, W. R. Boast, R. B. Liepold (Northlake), H. A. Hubbard (Northlake).
Automatic Electric (Canada) Ltd.; Automatic Electric Co., (USA).
Display will consist of a full range of electrical control apparatus including relays, class V relay†, rotary switches, stepping switches, level keys, push keys, lamps and dials. Included will be electrical control systems design and engineering service.

(Continued on page 59)

Growth and decay in electrical circuits

W. H. SHEPPARD, BSC (ENG)*

The theory of growth and decay in electrical circuits is often handled in a sketchy manner due to a lack of thorough understanding of the mathematical principles involved. This leads to various apparent paradoxes or anomalies when considering the geometrical properties of the functions concerned. This article is the result of a thorough investigation, in which all formulae were derived from first principles and compared with recognized works on the subject.

The scope of this investigation is limited to simple series combinations of passive components connected to a stable source of EMF (growth) or short-circuited (decay). It does not consider the effect of applied ac voltages. However, mechanical analogies are given for each of the electrical cases considered and it is hoped that the results will form a useful reference, not only in the design of electrical circuits, but also in the programming of analog computers for the solution of problems in vibration and flutter.

ELECTRICAL FUNDAMENTALS

These are well-known to most electronics engineers, but are reviewed here as an introduction to the subject of growth and decay.

Resistance: By Ohm's Law, if the temperature of a resistor remains constant, the current (i) is directly proportional to the applied EMF (e).

Whence, resistance $(R) = e/i$

or, $e = Ri$ (volts = ohms × amps)

It should be noted that "resistance" has no meaning until Ohm's Law is established.

Capacitance: The charge (q) on a capacitor is directly proportional to the applied EMF (e).

Whence, capacitance $(C) = q/e$

$$\text{or, } e = q/C \left(\text{volts} = \frac{\text{coulombs}}{\text{farads}} \right)$$

It may also be shown that the current (i) is directly proportional to the rate of change of charge, i.e.

$$i = dq/dt$$

It follows that if a capacitor and a resistor are in series, the EMF across the resistor $(e_R) = Rdq/dt$.

Inductance: The induced EMF (e_L) in an inductor is proportional to the rate of change of current and opposes the change.

$$\text{Whence, inductance } (L) = -\frac{e_L}{di/dt}$$

or, $e_L = -Ldi/dt$ (volts = henries × amps/sec)

If a capacitor is in series, $e_L = L \cdot d^2q/dt^2$.

BASIC MATHEMATICS

In what follows, pairs of components are considered in turn and then all three together. However, the mathematics to be used is discussed first to avoid confusing the exposition. This involves the solutions of simple differential equations and interpretation of their geometrical properties.

1. $dy/dx + ay = 0$

The solution is given by $y = re^{-ax}$

$$dy/dx = -are^{-ax} = -ay.$$

This is the exponential function in which the slope at any point is proportional to the ordinate y, and the curve is asymptotic to the x-axis (fig. 1). The subtangent at $x = 0$ is $1/a$ and independent of r. To all practical purposes, y is negligible at $5/a$ or $3\pi/2a$ $(4.7124/a)$.

2. $d^2y/dx^2 + a^2y = 0$

The solution is given by

$$y = A \sin ax + B \cos ax$$

$$dy/dx = a[A \cos ax - B \sin ax]$$

$$d^2y/dx^2 = -a^2[A \sin ax + B \cos ax] = -a^2y.$$

If $y = 0$ when $x = 0$,

$$y = r \sin ax \quad dy/dx = ra \cos ax$$

$$d^2y/dx^2 = ra^2 \sin ax$$

If $dy/dx = 0$ when $x = 0$,

$$y = r \cos ax \quad dy/dx = -ra \sin ax$$

$$d^2y/dx^2 = ra^2 \cos ax$$

These curves are sinusoidal as shown in fig. 2. Period $T = 1/a$.

3. $d^2y/dx^2 + \alpha dy/dx + \beta y = 0$

This equation has three solutions, depending on the discriminator of the operator equation.

$\beta > (\alpha/2)^2$ Let $a = \alpha/2$ and $b = \sqrt{\beta - (\alpha/2)^2}$

The equation may then be written

$$d^2y/dx^2 + 2a \cdot dy/dx + (a^2 + b^2)y = 0$$

and $y = e^{-ax}[A \sin bx + B \cos bx]$

$$dy/dx = -ae^{-ax}[A \sin bx + B \cos bx] + be^{-ax}[A \cos bx - B \sin bx]$$

$$d^2y/dx^2 = (a^2 - b^2)e^{-ax}[A \sin bx + B \cos bx] - 2abe^{-ax}[A \cos bx - B \sin bx]$$

These curves are sinusoidal-exponential as shown in fig. 3. They have exponential envelopes and the crests are also on exponential curves. It should be specially noted that the points of tangency and not the crests are mid-way between the points where $y = 0$. It follows that the lobes of the curve are "lop-sided" but the successive crests are displaced by equal amounts. Unfortunately the curves are often drawn sinusoidally and the apparent anomaly of the envelope agreeing with the equation explained as an approximation.

If $y = 0$ when $x = 0$,

$$y = re^{-ax} \sin bx$$

$$dy/dx = re^{-ax}[b \cos bx - a \sin bx]$$

$$d^2y/dx^2 = re^{-ax}[(a^2 - b^2) \sin bx - 2ab \cos bx]$$

When $y = 0$, $x = \pi/b, 2\pi/b, 3\pi/b$, etc.

Tangent points are $x = \pi/2b, 3\pi/2b, 5\pi/2b$, etc.

on curve $y = re^{-ax}$

Crest points are $x = \phi/b, (\pi + \phi)/b, (2\pi + \phi)/b$, etc.

where $\phi = \tan^{-1} b/a$ $(\cos \phi = \alpha/2\sqrt{\beta})$

$$\text{These are on curve } y = \frac{b}{\sqrt{a^2 + b^2}} re^{-ax}$$

*McGill University, Montreal.

If $dy/dx = 0$ when $x = 0$,

$$y = re^{-ax}\left(\cos bx + \frac{a}{b}\sin bx\right)$$

$$dy/dx = -r\left(\frac{a^2+b^2}{b}\right)e^{-ax}\sin bx$$

$$d^2y/dx^2 = -r(a^2+b^2)e^{-ax}\left(\cos bx - \frac{a}{b}\sin bx\right)$$

When $y = 0$, $x = (\pi - \phi)/b, (2\pi - \phi)/b, (3\pi - \phi)/b,$ etc.

Tangent points are $x = (\pi/2 - \phi)/b$, $(3\pi/2 - \phi)/b$, $(5\pi/2 - \phi)/b$, etc.

$$\text{on curve } y = \frac{\sqrt{a^2+b^2}}{b}re^{-ax}$$

Crest points are $x = 0$, π/b, $2\pi/b$, $3\pi/b$, etc. on $y = re^{-ax}$

The ratio of any pair of successive corresponding ordinates is constant and equal to $e^{-2\pi a/b}$. The natural logarithm $-2\pi a/b$ is termed the Logarithmic Decrement (δ). It applies particularly to the crests, but is often erroneously quoted as applying to the tangent and other points. The subtangent at $x = 0$ for the envelope or other exponential is $1/a$, independent of r or the other coefficients. The period T is $2\pi/b$.

$\beta < (\alpha/2)^2$ Let $a = \alpha/2$ and $b = \sqrt{(\alpha/2)^2 - \beta}$

The equation may then be written

$$d^2y/dx^2 + 2a\,.\,dy/dx + (a^2 - b^2)y = 0$$

and $y = e^{-ax}[A \sin h\, bx + B \cos h\, bx]$

$$dy/dx = -ae^{-ax}[A \sin h\, bx + B \cos h\, bx] + be^{-ax}[A \cos h\, bx + B \sin h\, bx]$$

$$d^2y/dx^2 = (a^2+b^2)e^{-ax}[A \sin h\, bx + B \cos h\, bx] - 2abe^{-ax}[A \cos h\, bx + B \sin h\, bx]$$

These curves are non-oscillatory.

If $y = 0$ when $x = 0$,

$$y = re^{-ax}\sin h\, bx$$

$$dy/dx = re^{-ax}(b \cos h\, bx - a \sin h\, bx)$$

$$d^2y/dx^2 = re^{-ax}[(a^2+b^2)\sin h\, bx - 2ab \cos h\, bx]$$

If $dy/dx = 0$ when $x = 0$,

$$y = re^{-ax}\left(\cos h\, bx + \frac{a}{b}\sin h\, bx\right)$$

$$dy/dx = -r\left(\frac{a^2-b^2}{b}\right)e^{-ax}\sin h\, bx$$

$$d^2y/dx^2 = -r(a^2-b^2)e^{-ax}\left(\cos h\, bx - \frac{a}{b}\sin h\, bx\right)$$

$\beta = (\alpha/2)^2$ Let $a = \alpha/2$

The equation may then be written

$$d^2y/dx^2 + 2a\,.\,dy/dx + a^2y = 0$$

If the previous solutions are applied the results are indeterminate. However, the following results apply:

$$y = e^{-ax}(Ax + B)$$

$$dy/dx = e^{-ax}(A - aAx - aB)$$

$$d^2y/dx^2 = e^{-ax}(a^2x - 2aA + a^2B)$$

These curves are also non-oscillatory.

If $dy/dx = 0$ when $x = 0$,

$$y = re^{-ax}(ax + 1)$$

$$dy/dx = ra^2xe^{-ax} \quad (x = 1/a,\ dy/dx \text{ is max.})$$

$$d^2y/dx^2 = ra^2e^{-ax}(ax - 1) \quad (x = 2/a,\ d^2y/dx^2 \text{ is max.})$$

These curves are shown in fig. 4. The curve for y changes gradually from sinusoidal to exponential. This curve is often described as approximately exponential, which is misleading since an exponential has a large initial slope, whereas the curve for y has zero initial slope. (It was an investigation of this paradox that lead the writer to make a thorough examination of this whole subject.) In this case y is negligible after $6/a$ or $2\pi/a$ ($= 6.2832/a$).

General considerations

If a constant is included in any of the above equations, it should be divided by the coefficient of y and subtracted from the formula for y, but not from the formulae for the derivatives. For example:

$$dy/dx + ay + b = 0 \qquad y = re^{-ax} - b/a$$

$$d^2y/dx^2 + \alpha dy/dx + \beta = 0$$

$$y = e^{-ax}(A \sin bx + B \cos bx) - \beta/\alpha$$

and similarly for other equations.

Exponential forms of trigonometrical results may be obtained by substituting

$$\sin x = \tfrac{1}{2}(e^{ix} - e^{-ix}) \qquad \cos x = \tfrac{1}{2}(e^{ix} + e^{-ix})$$

$$\sin h\, x = \tfrac{1}{2}(e^{x} - e^{-x}) \qquad \cos h\, x = \tfrac{1}{2}(e^{x} + e^{-x})$$

It should also be noted that a and b may have non-linear dimensions; this is important when checking equations.

EQUATIONS OF ELECTRICAL CIRCUITS

Resistance and Inductance $e = L\,.\,di/dt + Ri$

Decay $e = 0$ $\quad di/dt + Ri/L = 0$

From standard equations, $i = re^{-at}$

At $t = 0$, $i = I = E/R$, $\quad \therefore i = Ie^{-t/\tau}$

where I = initial current $= E/R$

and τ = time constant $= 1/a = L/R$.

Then $e_L = -Li/\tau$ and $e_R = Ri$.

Growth $e = E$ $\quad di/dt + Ri/L - E/L = 0$

$$i = re^{-at} + E/R$$

At $t = 0$, $i = 0$, $\quad \therefore i = I(1 - e^{-t/\tau})$

where I = final steady current $= E/R$.

Then $e_L = Li/\tau$ and $e_R = Ri$.

The time constant is the time that would be taken for complete growth or decay at the initial rate. This rate is $1/e$ ($= 0.3679$) for decay and $(1 - 1/e)$ for growth, expressed as a fraction of the total, and corresponds to the subtangent $1/a$.

The mechanical analogy of this circuit is a spherical mass falling freely in oil, the mass m corresponding to L, the viscosity v of the oil to R, and the velocity to i.

Growth or decay is usually considered complete after 5τ, but $3\pi\tau/2$ is a more fundamental expression.

Resistance and Capacitance $e = R\,.\,dq/dt + q/C$

Decay $e = 0$ $\quad dq/dt + q/RC = 0$

From standard equations $\quad q = re^{-at}$

At $t = 0$, $q = Q$, $i = I$ $\quad \therefore q = Qe^{-t/\tau}$

$$\text{and } i = -\frac{Q}{\tau}e^{-t/\tau} = Ie^{-t/\tau}$$

where $\tau = 1/a = RC$ and I = initial current $= -Q/T$.

Then $q = -\tau i \qquad e_R = Ri \qquad e_C = -\tau i/C$

Growth $e = E$ $\quad dq/dt + q/RC - E/R = 0$

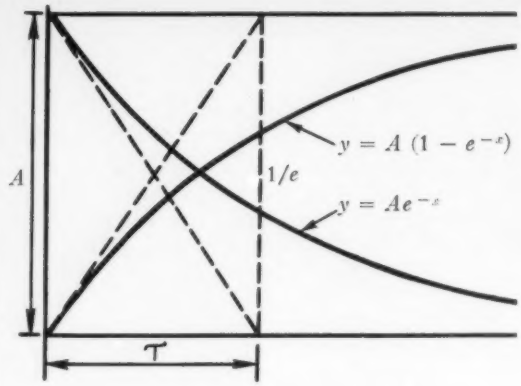
$$q = re^{-at} + EC = re^{-at} + Q$$

where Q = final charge $= EC$.

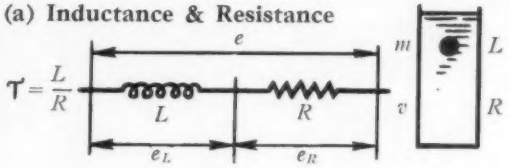
At $t = 0$, $q = 0$ $\quad \therefore q = Q(1 - e^{-t/\tau})$

$$\text{and } i = \frac{Q}{\tau}e^{-t/\tau} = Ie^{-t/\tau}$$

where I = initial current $= Q/\tau = E/R$.



(a) Inductance & Resistance



(b) Resistance & Capacitance

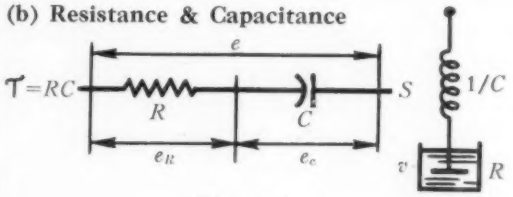
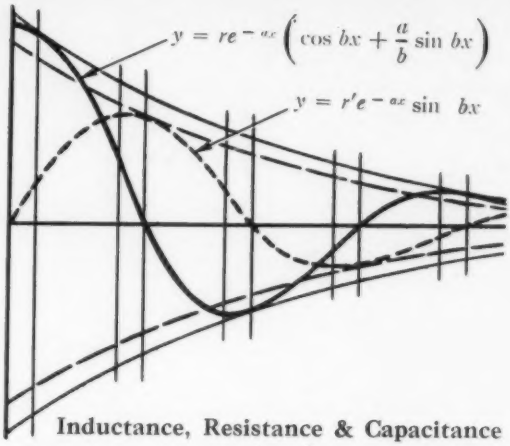


Figure 1.



Inductance, Resistance & Capacitance

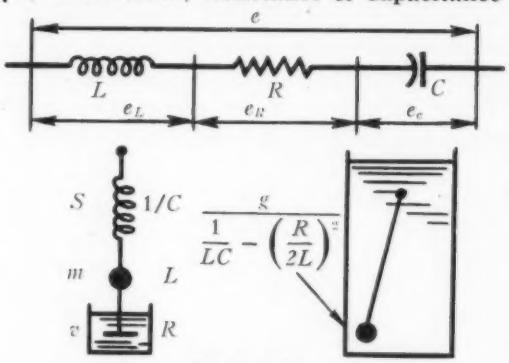
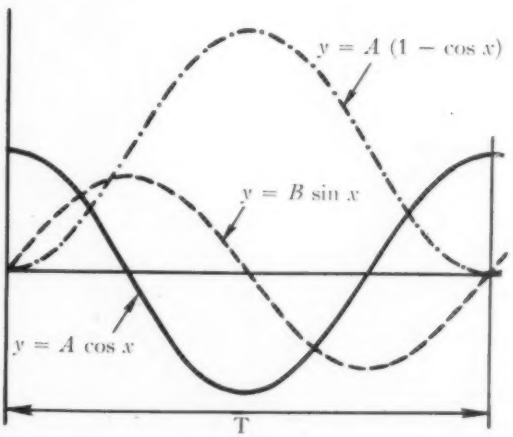


Figure 3.



Inductance & Capacitance

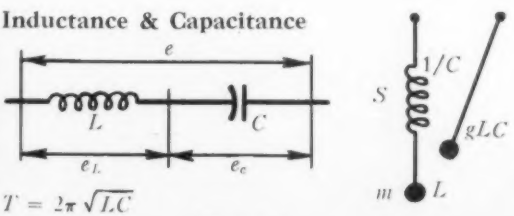


Figure 2.

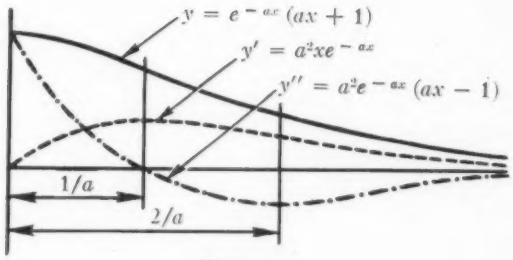


Figure 4.

Torsional Analogies

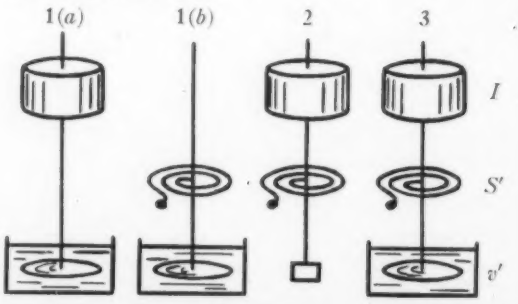


Figure 5.

Then $q = \tau\,(I - i)$ $e_R = Ri$ $e_C = \tau\,(I - i)\,/C$

In this case the mechanical analogy is a spring acting on a plate in oil, the stiffness of the spring S corresponding to the reciprocal of the capacitance$(1/C)$, and the viscosity v of the oil to the resistance R.

Again, growth or decay is considered complete after 5τ or $3\pi\tau/2$.

Inductance and Capacitance

$$e = L\,.\,d^2q/dt^2 + q/C$$

Decay $e = 0$ $\quad d^2q/dt^2 + q/LC = 0$

From standard equations, $\quad q = r\cos\omega t$

where $\omega = 1/\sqrt{LC}$

At $t = 0$, $\quad q = Q$, $\quad i = I$ $\quad \therefore q = Q\cos\omega t$

and $i = -Q\omega\sin\omega t = I\sin\omega t$

where Q = initial charge and I = initial current $= -Q\omega$

Then $e_L = LI\omega\cos\omega t = \dfrac{I}{\sqrt{L/C}}\cos\omega t$ $\quad e_C = q/C$

Growth $e = E$ $\quad d^2q/dt^2 + q/LC - E/L = 0$

$q = r\cos\omega t + EC = r\cos\omega t + Q$

At $t = 0$, $\quad q = 0$ $\quad \therefore q = Q\,(1 - \cos\omega t)$ where $Q = EC$

and $i = Q\omega\sin\omega t = I\sin\omega t$ where $I = EC\omega$

Then $e_L = LI\omega\cos\omega t$ $\quad e_C = q/C$.

This system is analogous to a mass m attached to a spring of stiffness S. The modulus of vibration σ is equal to S/m, whence $\omega = \sqrt{\sigma} = \sqrt{S/m}$. The frequency $N = \dfrac{1}{2\pi}\sqrt{S/m}$, and the period $T = 1/N = 2\pi\sqrt{m/S}$.

In the electrical circuit ω becomes the angular velocity of the rotating vector in radians per second, and is equal to $1/\sqrt{LC}$, whence $N = 1/2\pi\sqrt{LC}$. The length l of the equivalent simple pendulum is $g/\sigma = gLC$, whence its period $T = 2\pi\sqrt{l/g}$.

Resistance, Inductance and Capacitance

$$e = L\,.\,d^2q/dt^2 + R\,.\,dq/dt + q/C$$

This equation has three solutions as indicated in the mathematical introduction and it is convenient to consider growth and decay for each case separately.

$L > C\,(R/2)^2$

Decay $e = 0$ $\qquad d^2q/dt^2 + \dfrac{R}{L}\,dq/dt + q/LC = 0$

From standard equations $q = re^{-at}\left(\cos bt + \dfrac{a}{b}\sin bt\right)$

where $a = R/2L$ and

$$b = \sqrt{\frac{1}{LC} - \left(\frac{R}{2L}\right)^2} \quad (a^2 + b^2 = 1/LC)$$

At $t = 0$, $\quad q = Q$, $\quad \therefore q = Qe^{-at}\left(\cos bt + \dfrac{a}{b}\sin bt\right)$

and $i = -Q\left(\dfrac{a^2 + b^2}{b}\right)e^{-at}\sin bt$

i is a maximum I when $t = \phi/b$, where $\phi = \tan^{-1} b/a$

or $\phi = \tan^{-1}\sqrt{\dfrac{4L}{CR^2} - 1} = \cos^{-1}\dfrac{R}{2}\sqrt{\dfrac{C}{L}}$

Then $I = -Q\,(a^2 + b^2)^{\frac{1}{2}}\,e^{-a\phi/b} = -\dfrac{Q}{\sqrt{LC}}\,e^{-a\phi/b}$

whence $i = \dfrac{I}{\sqrt{1 - \dfrac{CR^2}{4L}}}\,e^{-a(t - \phi/b)}\sin bt$

$$e_L = -LQ\,(a^2 + b^2)\,e^{-at}\left(\cos bt - \frac{a}{b}\sin bt\right)$$

$$= -\frac{Q}{C}\,e^{-at}\left(\cos bt - \frac{a}{b}\sin bt\right)$$

$e_R = Ri$ $\qquad e_C = q/C$

Growth $d^2q/dt^2 + \dfrac{R}{L}\,.\,dq/dt + q/LC - E/L = 0$

$e = E$

$$q = re^{-at}\left(\cos bt + \frac{a}{b}\sin bt\right) + EC$$

At $t = 0$, $\quad q = 0$,

$$\therefore q = Q\left[1 - e^{-at}\left(\cos t\, bt + \frac{a}{b}\sin bt\right)\right]$$

where Q = final charge $= EC$.

i, e_L, e_R, and e_C are all (-1) times the values for decay.

The logarithmic decrement δ is $\pi a/b = \dfrac{\pi}{\sqrt{\dfrac{4L}{CR^2} - 1}}$.

The period $T = 2\pi/b = \dfrac{2\pi}{\sqrt{\dfrac{1}{LC} - \left(\dfrac{R}{2L}\right)^2}}$. Again,

decay or growth may be considered complete after 5τ or $3\pi\tau/2$ where $\tau = 2L/R$

$L < C\,(R/2)^2$

Decay $e = 0$ $\quad a = R/2L$ $\quad b = \sqrt{\left(\dfrac{R}{2L}\right)^2 - \dfrac{1}{LC}}$

$$a^2 - b^2 = 1/LC$$

$$q = Qe^{-at}\left(\cos h\, bt + \frac{a}{b}\sin h\, bt\right)$$

$$i = -Q\left(\frac{a^2 - b^2}{b}\right)e^{-at}\sin h\, bt$$

i is a maximum I when $t = \phi/b$, where $\phi = \tan h^{-1} b/a$

or $\phi = \tan h^{-1}\sqrt{1 - \dfrac{4L}{CR^2}} = \cos h^{-1}\dfrac{2}{R}\sqrt{\dfrac{L}{C}}$

Then $I = -Q\,(a^2 - b^2)^{\frac{1}{2}}\,e^{-a\phi/b} = -\dfrac{Q}{\sqrt{LC}}\,e^{-a\phi/b}$

whence $i = \dfrac{I}{\sqrt{\dfrac{CR^2}{4L} - 1}}\,e^{-a(t - \phi/b)}\sin h\, bt$

$$e_L = -\frac{Q}{C}\,e^{-at}\left(\cos h\ \mathrm{bt} - \frac{a}{b}\sin h\, bt\right)$$

$$= -LQ\,(a^2 - b^2)\,e^{-at}\left(\cos h\, bt - \frac{a}{b}\sin h\, bt\right)$$

$e_R = Ri$ $\qquad e_C = q/C$

Growth $e = E$

$$q = Q\left[1 - e^{-at}\left(\cos h\, bt + \frac{a}{b}\sin h\, bt\right)\right]$$

where Q = final charge $= EC$.

i, e_L, e_R, and e_C are all (-1) times the values for decay.

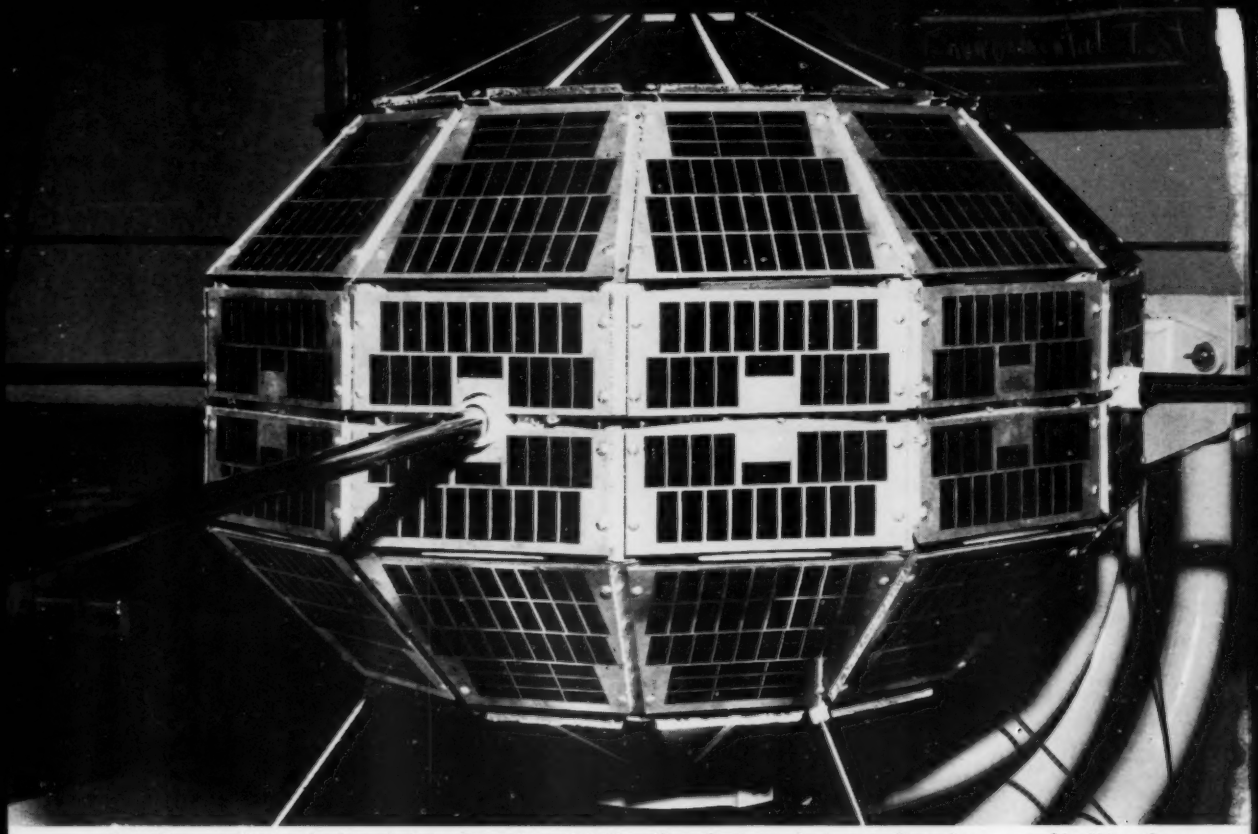
$L = C\,(R/2)^2$

Decay $e = 0$ $\quad a = R/L$ $\quad q = Qe^{-at}\,(at + 1)$

$= Qe^{-t/\tau}\,(t/\tau + 1)$

where $\tau = 1/a = L/R$.

(continued on page 54)



Canadian satellite, to be launched in the spring of 1962, will make ionospheric soundings from an orbit 600 miles up.

Canada's top-side sounder satellite will probe ionosphere next year

RICHARD J. GWYN, OTTAWA EDITOR

Defence Research Board scientists, in collaboration with the National Research Council and the U. S. National Aeronautics and Space Administration, have developed a Canadian satellite that will be used for ionosphere top-side soundings in 1962. The special self-extending antennas will be tested aboard a U. S. rocket later this year.

Canada's space program, costing at least $750,000, is right on schedule with our top-side sounding satellite due to be launched aboard an American rocket in the spring of 1962.

Defence Research scientists working on the project gave a progress report to newsmen in Ottawa, March 27.

This will be the first time a Canadian satellite has been fired into deep space. Rockets fired from Fort Churchill, Manitoba, have carried on a continuous program of exploring the lower atmosphere and last June some Canadian instruments were contained in a satellite launched by Johns Hopkins University.

The Canadian satellite will also be the first of its kind to measure the upper levels of the ionosphere, though both British and U. S. satellites will carry out broadly similar tasks during the same year. Previously all measurements of the ionosphere have been taken from ground stations

only able to explore its lower levels. The satellite will be fired above the ionosphere to record fundamental scientific information by radio sounding techniques.

New antennas to be used

The most dramatic feature of the satellite are the four pole-like antennas, the longest ever installed in an upper-space vehicle.

An original technique, first suggested by the National Research Council during the war and later put into practical use by the Army Development Establishment, has been adopted by DRB to pay out the antennas to their full length while in flight.

There are two pairs of antenna: two of 75 ft each making a tip-to-tip length of 150 ft, and two others of 37½ ft each, to cover different parts of the frequency spectrum.

They consist of thin, heat-treated steel strip, four inches wide, rolled up in drums inside the pay-load. On a given radio signal the antennas will be paid out by motor, the steel strip being formed into an inch-diameter cylinder to give a rigid tube. These tubes, while unable to support their own weight on the ground, will remain rigid in orbit due to the lack of gravity. (See CEE, March 1961, page 44, item 136).

The antennas will be given a trial this June when they will be fired some 625 miles in a U. S. four-stage Javelin rocket from Wallops Island, Virginia.

Details of satellite revealed

The satellite itself will have a total payload of 270 lb and resemble a flattened sphere. Its diameter will be 42 in. and its height 36 in.

It will be fired up 600 miles, have an orbital period of 105 minutes and a life-expectancy of one year.

The main components of the satellite instrumentation include:

A radio sounder, like a miniaturized radar set, which will transmit sounding pulses between 2 and 15 Mc and measure the time required for the echo's return.

The telemetry transmitter, operating at 136 Mc, which will relay the echo information to ground stations at Resolute Bay (the most important one); Prince Albert; Shirley Bay near Ottawa (the command post); and in Alaska, Florida, Chile, Ecuador, England and Wales.

A beacon transmitter to track the satellite and fix its position.

A command receiver to switch on the sounder, which is normally inactive.

Power supplies, rated at 12 watts, comprising four nickel-cadmium batteries recharged by solar cells, of which some 6,600 will be distributed over the surface of the satellite.

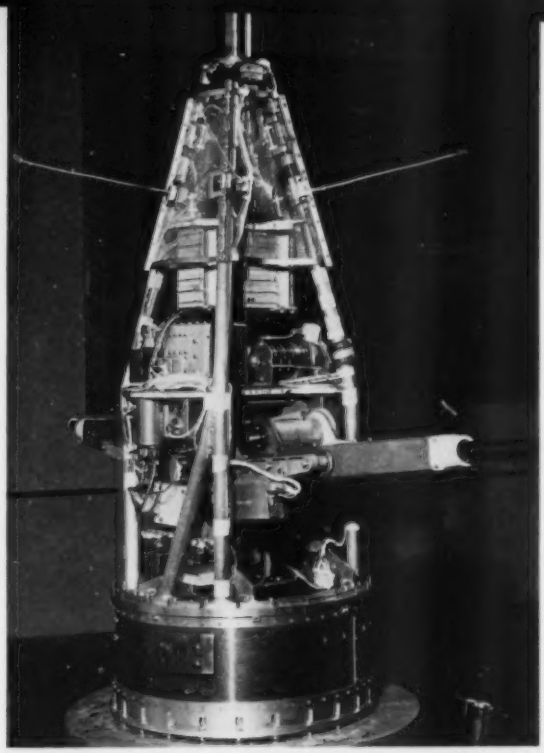
Four short antennas, some 20 in. long, for the telemetry equipment.

Government and industry collaborating

Most of the scientific and engineering work is being done by the Defence Research Board in conjunction with the U. S. National Aeronautics and Space Administration, the Defence Research Telecommunications Establishment and the National Research Council.

The main private contractor is The De Havilland Aircraft of Canada Ltd., Downsview, Ont., which has built the satellite shell and antennas. De Havilland has already made variations of the self-ejecting antenna for one U. S. satellite experiment and other contracts are in the offing.

Sinclair Radio Laboratories Ltd., also of Downsview, is designing and manufacturing the impedance-matching networks needed for the antennas.

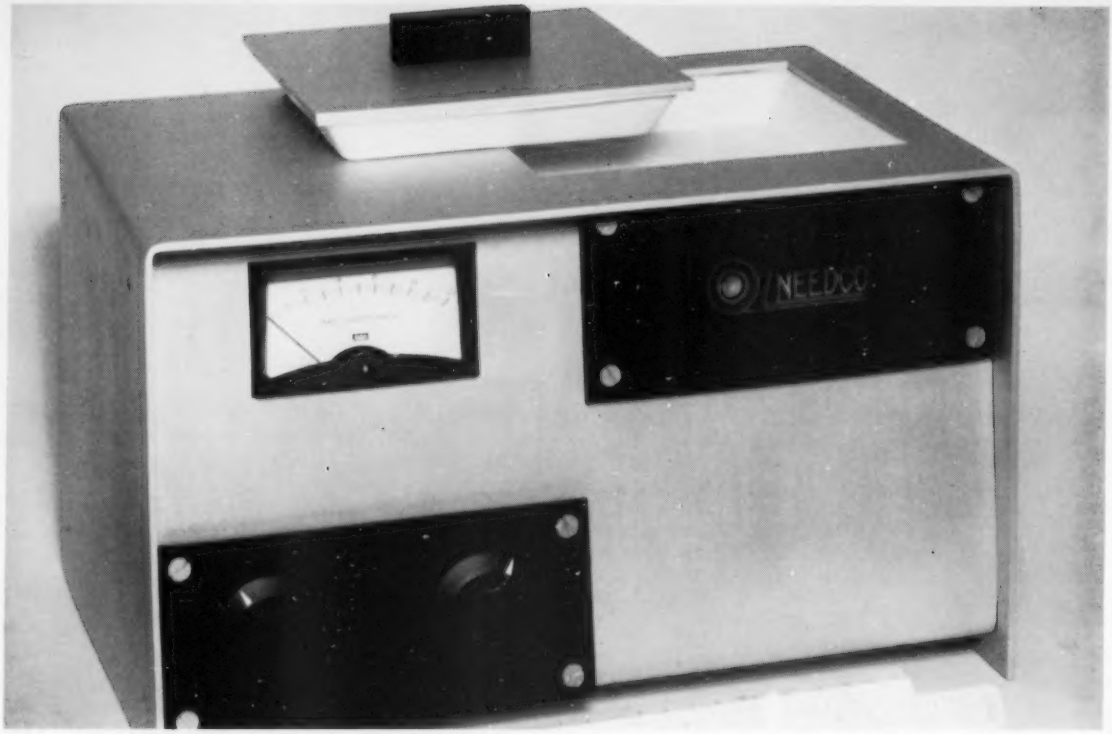


Rocket nose cone to be used in testing the satellite's self-extending antennas. Test is scheduled for June, 1961.

Dr. J. H. Chapman, deputy chief superintendent of DRB's telecommunications establishment at Shirley Bay, explains how 136-Mc link will carry sounding data from satellite.

In all four models of the satellite will be built: a mock-up already completed; a prototype to be sent this summer to Vandenburg Air Force Base where it will be launched next year aboard a Thor-Agena B rocket; and two actual complete satellites, one to be launched and the other as a standby.

END



Thermoelectric laboratory cooler, capable of controlling the temperature in its pot within 1 deg from —20 C to 100 C

Thermoelectricity permits new design concepts in cooling equipment

JAMES KEANE*

A laboratory cooler has been developed which uses standard thermoelectric modules and can provide temperatures down to —20 deg. C. It will hold an 800-mL beaker and keep the contents below zero C. A simple modification enables the unit to be used as an oven, providing temperatures up to 100 C.

While it is a simple matter to build a chamber to raise the temperature inside above ambient it was not so easy to lower temperature below ambient prior to the advent of thermoelectricity. Once standard modules became available, units such as the one shown in the photograph were a much easier proposition. This general purpose laboratory cooler was designed to reduce temperatures to —20 C and, with suitable modification, to go up to 100 C as well. The cooled chamber is a cast aluminum pot approximately 5 in. square by 5½ in. deep. Standard Frigistor cooling modules are used with a water-cooling circuit around the outside.

Such a thermoelectric cooler has many applications. It can be used as a zero deg C reference bath, or for checking the thermal design of transistor circuits. The temperature can be controlled by either external or internal devices, and even without temperature control the cooler can be used as a storage bath to extend the pot-life of epoxy resins.

A cooling capacity of 20 watts at a ΔT of 15 C below ambient was originally specified. Since the ambient is the temperature of the cooling water, the temperature difference between the inside and outside of the pot would be about 20 C with 20 watts pumping, the actual figure depending on the ambient air and water temperatures. The

* Head, Applications Department, Needco Cooling Semiconductors Ltd., Montreal.

pot was to contain an 800-mL beaker and keep its contents below zero C; or a test-tube rack and water, with ethylene glycol or other anti-freeze compounds. With temperature control to within one degree the cooler could then preserve biological specimens prior to examination.

Design considerations

The first part of the design undertaken was that of the cooling pot itself and the problems associated with the attachment of the standard modules with as little thermal loss as possible. In the prototype it was decided to weld a rectangular pot together, using ⅛-in.-thick material and to braze on to the side eight pads ⅜ in. thick. These pads were placed at the top in order that the convection would be downward. The pads were carefully ground to a 32-microinch finish ready for the placement of the standard F-8 modules. We decided to put on eight pads so that we could later use eight modules for a more powerful device. All eight were ground and four of them were covered with masking tape to facilitate removal of the Styrofoam which was to be used for thermal insulation. The whole pot was then bright anodized to provide a protective coating and electrical insulation between the Frigistor modules and the pot itself.

Several methods of glueing the Frigistors to the flat faces were tried, but difficulty was encountered with voids and too thick a layer of epoxy. This was eventually overcome with a process of rubbing the Frigistor module backwards and forwards across the ground face, slowly reducing the thickness of the film until a sudden increase in the viscosity of the epoxy showed that it was beginning to break up.

A test was performed by permitting a defunct module to cure and then forcing it off to see how the film was distributed. It appeared that all eight bridges on the cold side of the module were covered with epoxy and that the join was free from voids.

In order to ease the process of reducing the thickness of the epoxy film the whole pot was put into an oven and raised to about 50 C. This caused the epoxy to flow much more readily and resulted in a film which, while it could not be measured, appeared to be somewhat less than one thousandth of an inch. It was thought that this film would provide adequate electrical insulation for the copper water-cooled heat sinks which were to be used on the hot side of the Frigistors.

This proved not to be the case due to small burrs at the junction between copper and epoxy on the Frigistor. A short period of hand lapping removed them. The Frigistors were attached one at a time with clamps and rubber pressure pads and then the whole assembly was cured at 80 C. This resulted in a very fine bond with a fillet of epoxy surrounding the Frigistor module.

The copper water-cooled heat sinks with their faces were then attached to the other side of the Frigistor using the same technique. As mentioned previously, this did not work, a continuity check showing that short circuits appeared which would have reduced the cooling effect. To overcome this and still use the copper heat sinks we developed a technique of rolling mylar film on to the ground surface of the Frigistor and excluding most of the epoxy from underneath it. When the epoxy color almost disappeared and became transparent the epoxy resin film was cured in the oven.

When this cured film was examined very carefully it was discovered to be just as flat as the surface of the Frigistor and to provide a suitable base upon which to attach the heat sinks. The same process of rubbing the heat sink on to the prepared surface in order to reduce epoxy film was used, and when all four had been installed, the assembly was cured for the third time.

The four Frigistors were arranged alternately around the pot, and the water circuit was made, using rubber tubing. The electrical circuit for the Frigistors was made by clamping all four together. Both the water and the electrical circuits were connected in series.

When the pot was completed and its plastic bezel put on, the first tests were carried out. With the whole assembly insulated with 1½ in. of Santocel powder, the temperature was readily reduced to the values required. With water in the pot the temperature went down to —2 C in about three and a half hours: super-cooling had taken place. Stirring the bottom of the pot with a thermometer caused the water to freeze suddenly, and great numbers of beautiful multi-pointed ice crystals appeared almost instantly. The temperature then rose to zero deg C and a quarter of an inch of ice appeared all the way around the periphery of the pot at the end of a further one hour.

Economics were important in design of power supply

We concluded that this pot design was satisfactory and proceeded to design the cabinet and the power supply. The power supply was tackled first in order to establish its size which, to a large measure, was determined by the ripple requirements. For 5% ripple the choke would have been prohibitively large and it was decided to see what temperature loss resulted from permitting larger amounts of ripple. A single 1-mh choke was tried first with a bridge rectifier and the temperature run was performed again. It took a few minutes longer for the water to go from 15 C to zero C, but since the unit exceeded the requirements, it was decided to establish this as the final design.

The diodes were mounted on a heat sink and the water circuit routed around them so that the temperature rise in the case would be kept to a minimum. This heat sink would also act as a thermal shunt to conduct heat along the chassis from the transformer and choke. This system was found to work very well and the diodes, when running at 14 amps, were within 3 C of the water temperature at all times. This meant that we could have used much smaller diodes and over-rated them, but it was decided that the added safety factor was well worth while.

Once the size of the power supply had been established, the case design could be started and the control circuit could be planned. It was decided that the first model would be made without internal temperature control, but would be provided with a relay to enable an external controller to be used. Either a built-in thermocouple or a mercury-in-glass contact thermometer, immersed in the water, would provide a suitable temperature sensing device.

Protection of Frigistors

A simple device is included to protect the cooling modules against the possibility that the unit would be run without its cooling water. A thermostat with a differential of about 20 C is screwed to the outside of one of the heat sinks. The water circulating through the heat sink normally keeps the thermostat closed, but when the temperature rises to 80 C due to lack of cooling water, it opens and switches off the current. A test was set up on cooler No. 510 to check the operation of the switch.

The pot was filled with tap water at 5 C to within ¼ in. of the top. The unit was switched on at its maximum current of 20 amps without cooling water circulating, and left to run overnight. As a control, one cooling run was done first, showing that the time to freeze from 4 C was 85 minutes. At the end of the 23½-hour run, the temperature inside the pot had been stabilized at 50 C for 12½ hours, and had not drifted more than one-half degree from this figure. It was found that one of the epoxy joints on a hot face had failed, due to insufficient cleaning of the heat sink. A leak had also developed in the water circuit

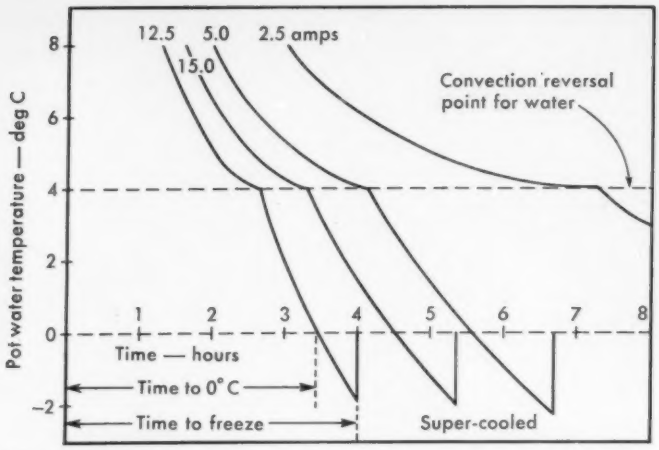


Fig. 1. Results of preliminary tests on laboratory cooler #510 with cooling water at 5 deg C and current varied from 2.5 to 15.0 amps.

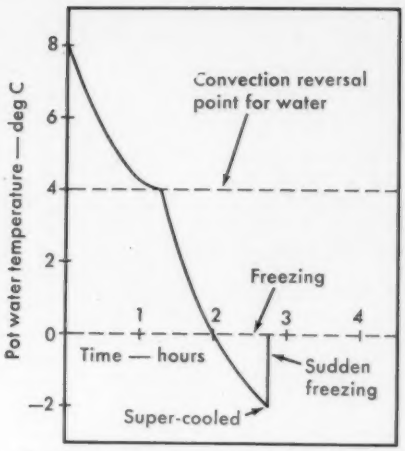


Fig. 2. Typical curve for free convective cooling, at optimum current of 12.5 amps.

where one push-fit rubber tube connection had relaxed as the temperature on the hot side rose to 80 C.

A cooling run was then performed at the same current of 20 amps and no difference could be detected in the freezing time. It was concluded that the polyurethane foam used to encapsulate the whole assembly acted as a clamp to hold the heat sink in close enough contact to ensure effective heat transfer, even though the mechanical bond of epoxy resin was fractured. To ensure that these mishaps would not occur in the field, it was decided to augment the epoxy resin with a mechanical clamp and to use circular clips on all water pipe joints.

Human factors governed cabinet design

A problem in industrial design had to be solved to produce a cabinet that would be pleasing to the eye. Contrasting panels are set away from the main front panel and the cover overhangs the whole front face of the unit. It was decided, however, that the ornamental screw heads would not be used on future models.

The spaced dummy panels serve the added purpose of introducing the next series of instruments which are to be air-cooled rather than water-cooled. In these the air can be taken in through concealed louvres on the front panel and expelled out the back, without changing the basic appearance of the design. The front panel design is arranged to have correct perspective when viewed by an individual 5 ft. 6 in. high, standing 3 ft. away from the instrument. This means that the front elevation of the cooler looks incorrect as drawn, but this incorrectness disappears when the unit is viewed from a standing position. The controls are kept as simple as possible and include only the on/off switch and a rheostat to change the current from 2 amps to 15 amps, a little over the optimum current for maximum ΔT.

Preliminary tests

Unit No. 510 was tested fairly completely, the first tests being temperature runs as shown in fig. 1, with the cooling water at 5 C and the current adjusted to values between 2½ and 15 amps at 2½-amp intervals. The pot was filled with tap water to within ¼ in. of the top and a small resistance heater was used to raise the temperature to the starting point of 50 C. The cooling unit was switched on and temperature plotted against time on a circular chart recorder, showing the time to 0 C and the time to freeze.

The difference between these times is due to impurities in the water that cause it to cool below its normal freezing point. It remains liquid for over an hour (in one case for over two hours), before suddenly freezing into a mushy mixture of water and ice. The super-cooled temperature rises slightly as the freezings progress because the nucleation centres gradually settle out and the water becomes purer.

These tests are summarized in fig. 2. It should be noted that free convective heat transfer was used — the times would be considerably reduced if a stirrer were used. The pot freezes solid within two to three hours of initial freezing.

A later unit in this series will have twice the cooling power; the present power supply has been designed to supply the optimum current for this unit.

Conclusions

The completed unit performs well. The power pumped starts at 40 watts when the water in the pot is at 15 C and falls linearly to 20 watts at 0 C. Exact measurements are being made to determine leakage at various temperatures and to see how the insulation can be improved. It should be possible to go down to —30 C with a suitable heat transfer medium, thicker insulation, and a better seal between the lid and the pot. These improvements should also lead to an increased rate of temperature drop, and a wider range of applications for the unit.

The cooler can be used as a heater up to 100 C simply by reversing the current flow. The power required is less than half that which would be used by a resistance heater. The coefficient of performance of the unit (defined as Q_c/w = watts pumped/power input) is 0.5 at 0 C and much greater than this during the initial pull-down period. When the unit is used as a heater the coefficient of performance (now defined as $(Q_c + W)/w$ = total output/power input) is much greater — of the order of 2.0 — since the heat generated within the device is pushed in the direction we wish it to go. Thus a simple unit can control temperature within 1 C from —30 C to +100 C. END

IRE International Convention

New solid state devices enter market

IAN R. DUTTON, ASSOCIATE EDITOR

The 1961 International Convention of the Institute of Radio Engineers, held in New York, March 20-23, presented some real dilemmas for public relations people. There were no clear-cut headline items to shout out to all the world — no astronauts in orbit, no radical breakthroughs in any segment of electronics and, no stereo broadcasting. As for microwave equipment, transistors and color TV, . . . they have been around long enough to be "old hat" to the public.

For the engineers, however, 1961 was one of the best years within recent times. A lot of genuine progress was reported at the technical sessions and the exhibits.

Solid-state devices made encouraging and impressive gains during the past year. Thermoelectric devices, semiconductors, transducers, electroluminescent devices and integrated circuits caught the attention of visiting scientists and engineers.

W. R. Stubstad, Collins Radio Co. delivered a paper describing the design of thermoelectric spot cooling units for electronic equipment. They can be applied to reduce the operating temperature of critical components in flight vehicles where space and weight limitations do not permit the use of conventional cooling equipment.

During the panel discussion on new energy sources, R. L. Petritz of Texas Instruments, Inc. described his experiences on a recent trip to U.S.S.R. He found the Russians reluctant to discuss their work with thermoelectric devices used to generate power. However, he found that domestic refrigerators, equipped with thermoelectric elements, are being prepared for production. When manufactured in quantity, 100-liter refrigerators are expected to cost about $75.

At the Coliseum, Westinghouse Electric Corp. had a thermoelectric power generator in operation. Designed for the Northern Illinois Gas Co., the 100-watt generator will be used for cathodic protection of pipelines and for charging batteries of a microwave relay system. Output of the propane-burning generator is 11 volts at 10 amperes dc. A static converter changes this to 48 volts at 2.1 amperes dc.

General Instrument Corp. has produced a similar unit for the U.S. Coast Guard. With an output of 5 watts; it will operate continuously for a year on 65 gallons of propane. Its function is to provide power for marine navigation aids.

A new device for converting electrical energy into ultrasonic energy and vice versa at microwave frequencies was described in a paper by D. L. White of Bell Telephone Laboratories. It is a piezoelectric transducer utilizing a semiconductor depletion layer. It is expected to be employed primarily in ultrasonic delay lines.

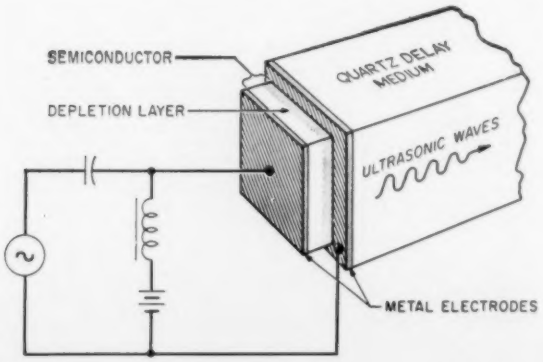
The transducer consists of a plate of piezoelectric semiconductor, such as gallium arsenide, on which a thin metal film is deposited. The film constitutes a nonohmic rectifying contact which causes a depletion layer to form. (A depletion layer is a thin region of high resistivity that forms at the interface of two dissimilar materials such as a p-n junction in a semiconductor or a rectifying metal-to-semiconductor contact. The difference in Fermi levels of the two adjacent materials usually gives rise to an internal electric field which sweeps or "depletes" the thin interface region free of mobile charge carriers, thereby increasing its resistance.) The thickness of the depletion layer can be controlled with a negative bias voltage across the interface.

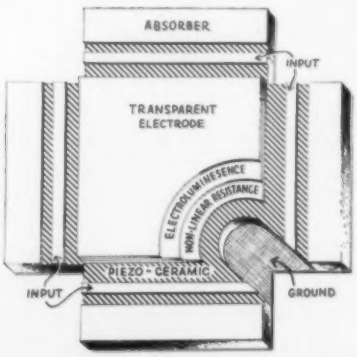
When an ac voltage is applied, most of the voltage drop occurs across the layer and the layer behaves in a manner similar to a very thin piezoelectric crystal which is bonded to a solid. Since the layer is thin, 10^{-3} to 10^{-5} cm, the electric field is very large and considerable piezoelectric stress can be produced in the layer.

The depletion layer transducer has several advantages over an ordinary transducer:

(a) Because the layer is so thin, the greatest efficiency of the transducer is at high frequencies, 1,000 to 10,000 Mc. (b) The thickness of the layer, hence the resonant frequency of the transducer can be varied by varying the dc bias voltage. (c) Present models measured at 600 Mc have bandwidths of 5%, an order of magnitude larger than typical ceramic transducers operating at frequencies below 10 Mc. This means that a comparable increase should be expected in the amount of information which can be transmitted. (d) The transducer is relatively simple to make and easy to handle.

In a paper "Solid state display device" Stephen Yando





John Sutcliffe, right, of Guildline Instruments, Smiths Falls, Ont., again had his primary standards instruments on display in the Sensitive Research Instrument booth.

Westinghouse Electric Corp. used this model train in their booth to show operation of a thermoelectric generator which burns propane to produce 40 watts output.

of General Telephone & Electronics Laboratories Inc. described a display device utilizing piezoelectricity and electroluminescence. It is a panel less than half an inch thick that produces a moving light image.

The panel is composed of a piezoelectric ceramic material, one surface of which is coated with a layer of electroluminescent material. When voltage pulses are applied to several electrodes on the edges of the panel, traveling acoustical waves are introduced into the ceramic material. Electric fields which accompany these acoustical waves interact with the electroluminescent layer to produce a "spot" of illumination on the panel. The position of the "spot" is controlled by varying the relative timing of the electrical pulses to produce a wave pattern. The light intensity of the "spot" is modulated by an electric field applied to a transparent conductive layer covering the electroluminescent layer.

As suitably timed input signals are applied, a series of light spots or lines are produced which can form an image. By varying the timing of the impulses, the image can be made to move about the panel. In certain applications, only a dot of light will be required. Therefore, nonlinear resistance material can be included in the panel to eliminate background light, leaving only the desired display.

General Electric Co. held seminars to introduce its Thermionic Integrated Micro Module (TIMM) circuits. They are a step toward high-component-density miniaturization, and are expected to be ready for practical use in the near future. Operating at high temperatures, TIMM circuits can have a component density rate as high as one million parts per cubic foot.

Fairchild Semiconductor Corp. introduced the first of a family of Micrologic elements. It is a flip-flop, designed for use in digital computers operating at bit rates in excess of 1 Mc. Five other devices in the family — gate, half-shift register, buffer, half adder, and counter adapter — will be introduced shortly. The elements use direct-coupled transistor logic circuitry. The flip-flop is made by diffusing transistors and resistors for many units into a single slab of silicon. The metallic intraconnections are then deposited on top of the slab and the slab is cut into individual elements. The elements are then mounted in JEDEC TO-5 or TO-18 cases with 18 leads.

Obstacle detector aids blind people

J. M. Benjamin, Jr. of Biophysical Electronics, Inc. described an obstacle detector and a curb detector designed to aid blind people. Both instruments range by optical triangulation using light in the near infra-red and a germanium photodiode light detector. Output to the blind user is from a tactile stimulator mounted in the handle of the instrument. Range of detection is 9 ft., but this can be reduced to 5 ft. by depressing a switch in the handle.

Light for the obstacle detector is produced by a special xenon glow discharge lamp that emits light pulses 300 usec long at a 20 cps rate. The light is focused by a special 3-in focal length f/1.0 Fresnel lens onto the target. Another lens centred 3 in. above the sending lens gathers diffusely-reflected rays from the target, focusing them on one of two adjacent photodiodes, depending on range. Output from the photodiodes is amplified, passed through a gate synchronized with the light pulses, then operates a one-shot 20% duty cycle multivibrator which operates the tactile stimulator.

The curb detector will detect holes, down-curbs over 3 in., up-curbs over 6 in. and low obstacles. A chopped incandescent light is focused on the ground by the upper of two plastic Fresnel lenses. The diffuse reflection of this light is imaged by the lower Fresnel lens on a pair of

(Continued on page 54)

. . . and some went home laden with "knowledge."

Canadian Military Electronic Components Symposium

Government-industry must reappraise their positions on military components

IAN R. DUTTON, ASSOCIATE EDITOR

In the finest traditional military style, speakers at the Canadian Military Electronic Components Symposium moved out onto the firing line one by one to face some accurate sniping from industry members in the audience.

The symposium was sponsored by the three Services, working in close cooperation with interested government departments and the Electronic Industries Association of Canada. Meetings were held at the National Gallery, Ottawa, April 11 and 12.

When the air had cleared at the conclusion of the two-day symposium, these facts stood out:

(a) A conference of this type between industry and military customers was long overdue.

(b) The customer (Armed Services) deserves credit for taking the initiative in calling a conference.

(c) The Services are going to need, and will demand, greater reliability in electronic components. They will also demand accurate figures on the failure rate of components under specified operating conditions.

(d) A number of completely new components will be requested from time-to-time.

(e) Satisfying the requirements of the Services is going to cost a lot of money, both for production and testing.

(f) The market in Canada for military components, built and tested according to desired specifications, may not be large enough to justify the large capital expenditures facing manufacturers.

(g) Forecasts on military markets do not exist.

(h) Some testing procedures are not realistic.

(i) Defence production sharing can provide, and is providing, wider markets for Canadian military components

(j) Services and manufacturers must maintain closer liaison to recognize each other's problems and find solutions within the economic means of our industry and, indeed, our taxpayers.

One of the major barriers manufacturers face when entering the military component market is the high cost of test equipment. G. C. Rowe of DDP told the audience that it would cost approximately $30,000 to install sufficient equipment — shaker tables, environmental chambers, shock testers, etc. — to permit manufacturers to carry out minimum testing of components.

Manufacturers countered with the complaint that they could not see sufficient military business in the immediate future to justify such high capital expenditures. The services would have to accept commercial components, or the government would have to provide some financial assistance in setting up testing facilities.

The prospect of centralized testing facilities was discussed, but representatives from CAMESA emphasized the importance of in-plant test facilities on the long-term basis. They ensure proper quality control and assist in improvement of components through development and research. While CAMESA can provide limited assistance in the reliability testing of components, it wants manufacturers to instal their own equipment.

Some Canadian subsidiaries of U.S. companies asked why it was not possible to have their testing done by the parent organization, where complete facilities existed. At the present time this is not possible because a member of DND Inspection Services must be present during testing.

One manufacturer expressed concern about the em-

Dr. R. Jackson, RCA Victor Research Labs shows new survey meter with solid state alpha detectors to (standing l-r): H. Lysons, secretary ECRDC; H. Reiche, symposium chairman; F. W. Simpson, DRTE; Dr. F. J. Burger, TCC Canada Ltd.; (seated) Prof. O. Knop, N. S. Tech. College; Dr. G. Sinclair, chairman of ECRDC.

The sessions on military electronic component reliability and production sparked lively discussion from members of the audience. Here are some of the participants of the sessions. (l-r) C. L. Soucy, RCAF; S/L A. E. Kelly, RCAF (Telecommunications); A. P. Harris, CAMESA; V. E. Tant, DDP; R. B. Preziosi, DND Inspection Services.

phasis placed upon "life testing". The present trend is to rate reliability of components in terms of the number of hours they will continue operating under normal, or near-normal conditions. The majority of failures in the field, however, are linked with some abnormal environmental condition which hastens failure.

Government people recognized the limitations of their reliability program, but pointed out that they had to start somewhere, and progress was being made. The real danger to the component manufacturer could be lack of understanding on the part of equipment manufacturers. The latter must interpret test results properly to avoid specifying and buying the wrong components.

Production sharing can extend markets

The Canada-U. S. defence production-sharing program holds promise of providing Canadian manufacturers with markets that are large enough to support expensive test facilities. However, if Canadians hope to win U.S. military contracts they must be prepared to play the game under U.S. rules. So what do they do: go after the contracts first and then instal the equipment; or instal the equipment and then go after contracts?

The first approach insults the intelligence of the customer; the second strains the budget of the manufacturer. Obviously this points to a compromise approach, and that is how most manufacturers operate. But there may be better compromises than the ones currently used. That in itself is sufficient justification for holding further meetings such as this symposium.

The production sharing program has been working much better than many skeptical Canadians anticipated. Reporting on the progress to date, M. L. Card of DDP released these figures on prime and sub-contracts placed in Canada for specific military hardware (all types) but not counting such items as fuel, construction, rental of communications circuits and other such services:

	Prime	Sub	P&S
1959	51	45.3	96.3
1960	61	51.7	112.7
Total	112	97.0	209.0

All figures are in millions of dollars.

For the electronics industry alone, totals from the start of the program in January 1959 until the end of March, 1961 are:

Prime Contracts	$45.3 million
Sub-contracts	$55 million
Total	$100.3 million

The Canadian Military Electronic Components Symposium served a useful function. The organizers, moderators and speakers deserve a vote of thanks, particularly if it will encourage them in attempting additional meetings. Chairman of the symposium was H. Reiche of the Army Development Establishment.

A symposium record is being printed for distribution to all those who registered for the two-day meeting. A limited number of extra copies will be available and may be obtained by writing to Mr. Reiche, Army Development Establishment, Dept. of National Defence, Ottawa. END

IRE International Convention — continued

photodiodes mounted side by side on a servoactuator. As the range changes, due to walk-in motion (from 3 to 7 ft.), the actuator is positioned to produce equal light signals from both photodiodes. A down-curb casts a shadow causing light to be lost. An up-curb reduces the range so the system cannot follow, again causing the light to be lost. Light loss is signaled to the user.

Ionized gas trail antennas

B. M. Mindes of ITT Federal Laboratories has proposed a system employing ionized gas trails as antennas. The applications considered include utilizing the exhaust trails of reaction motors and possibly the plasma sheath enveloping a vehicle re-entering the Earth's atmosphere. In his paper, Mr. Mindes developed an expression for conductivity in terms of the excitation frequency and the significant gas parameters: electron density, plasma frequency and collision frequency. Such an antenna could be used at frequencies below 1 Mc where solid antennas are difficult to use because of their excessive length.

Growth and decay — continued

$$i = -Q\frac{t}{\tau^2}e^{-t/\tau}$$

i is a maximum I when $t = \tau$

so $I = -\frac{Q}{\tau}e^{-1}$ and $i = \frac{t}{\tau}I\,e^{1-t/\tau}$

$$e_L = \frac{LQ}{\tau^2}e^{-t/\tau}(1 - t/\tau) \quad e_R = Ri \quad e_C = q/C$$

Growth $e = E \quad q = Q[1 - e^{-at}(at - 1)]$

where Q = final charge = EC.

i, e_L, e_R, and e_C are all (-1) times the values for decay.

In this general case the mechanical analogy is a mass m attached to a spring of stiffness S and a dashpot of virtual viscosity v. The natural frequency N for the oscillatory case is $1/2\pi\sqrt{LC}$, but the damped frequency N′ is $\frac{1}{2\pi}\sqrt{\frac{1}{LC} - \left(\frac{R}{2L}\right)^2}$. The length of the equivalent simple pendulum is $g/\sqrt{\frac{1}{LC} - \left(\frac{R}{2L}\right)^2}$, the vibration modulus corresponding to $\frac{1}{LC} - \left(\frac{R}{2L}\right)^2$ as against $1/LC$ for undamped motion. $R/2L$ is termed the "Resistance Factor."

Torsional analogies

By substituting moment of inertia for m or L, torsional stiffness for S or $1/C$, and moment of viscosity for v or R, torsional analogies may be derived. These are important in the design of electrical indicating instruments. Viscosity is usually simulated by eddy currents in a metal disc mounted between the poles of a fixed magnet. As with dashpots, it should be noted that the drag is approximately proportional to v^2, but the results obtained using v are not far different. END

Patent news

Scientists in Government agencies such as National Research Council and Defence Research Board frequently invent circuits or devices having commercial application. In such cases, patents are taken out and made available to industry. Persons interested in obtaining licences should contact Canadian Patents and Developments Ltd., 100 Sussex Dr., Ottawa 2.

Diode ring circuit

Case No. 2795

Inventor: Philip M. Thompson

This invention arose from the development at Defence Research Telecommunications Establishment, Ottawa, of a lightweight air-borne navigational system. It relates to modulation and detection apparatus of the diode ring type. The invention is patented in U.S.A. Patents have been applied for in Canada and the United Kingdom.

The conventional diode ring modulator shown in Figure 1 may be used as a switch controlling signal polarity, as a phase sensitive rectifier, or as a suppressed carrier modulator.

If both input currents to the diode ring D1 are supplied from constant current sources with the reference current being the larger, then the reference current will drive one pair of diodes (d1 d2 or d3 d4) into conduction, while the other pair will be cut off. Any signal current injected into the centre taps of the transformers T1 and T2 can flow only in one-half of T1 at a time, so that the diodes perform simple switching between the primary winding halves in accordance with the reference current.

If T1 and T2 are lossless and the reverse conduction of the cut-off diodes is zero, the whole signal current is transferred without loss to the output circuit. The cut-off diodes do, however, pass a small current because of the reverse voltage impressed on them by the voltage across the conducting diodes. This is the main source of unbalance in the modulator circuit.

In practice, performance will suffer because the input and output impedance depart from the ideal infinite and zero. Performance need not be significantly degraded however, if these conditions are approximated by making the signal and reference source inputs much greater than the output impedance. Nonetheless, it still remains necessary to keep the voltage across the load very small, because it is reflected by T1 as a bias across the non-conducting diodes, which might cause them to conduct. Thus, the output should, in effect, be current only, to obtain balance at the expense of efficiency.

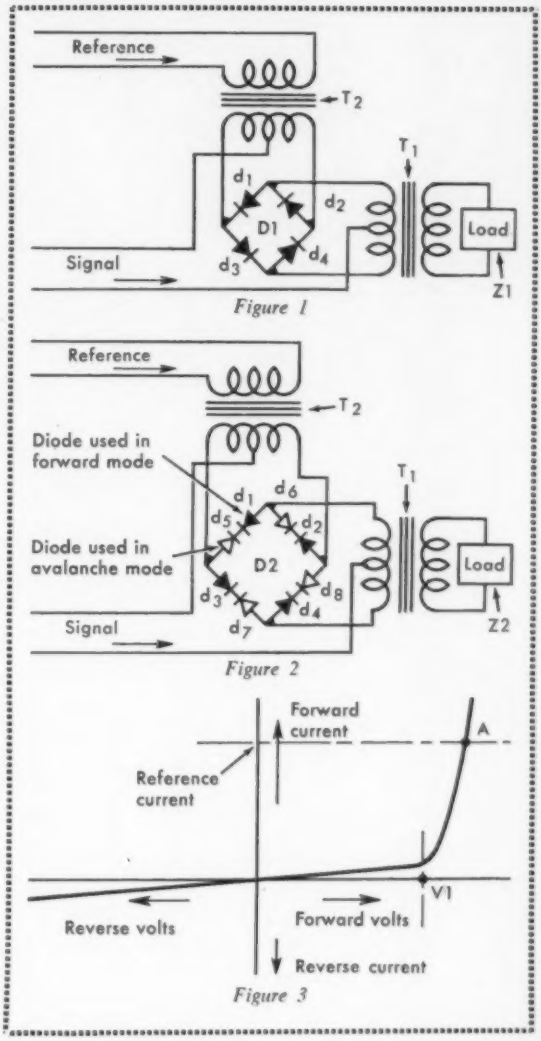
This invention, however, provides a diode ring circuit which does not require that the output voltage be very small. This is accomplished by making each arm of the ring from a pair of diodes connected so that the pair will remain non-conducting even in the presence of substantial forward voltage.

Each pair comprises a diode of low avalanche breakdown voltage connected in series with a forward mode diode of higher breakdown voltage, as shown in Figure 2. A graph of the current-voltage characteristics of such a pair is shown as Figure 3.

This new circuit acts as a switch in a similar way to that in Figure 1 but the switched-off diodes remain non-conducting until the voltage reflected across them by the load reaches the value V1 shown in Figure 3. As before the circuit must be driven by circuits of much higher impedance than the load, but now the load impedance modified by the turns ratio of T1 can be made to the optimum load impedance of the amplifier supplying the signal current. Furthermore, circuit efficiency can be made to approach 100%, because the forward impedances of the pairs of diodes and the secondary resistance of the transformers can be made to total much less than the load resistance.

The circuits have been described with reference to semi-conductor diodes but other types could be used; for example, the diodes used in the forward mode could be conventional thermionic diodes, those used in the avalanche mode, gas regulator tubes.

(Continued on page 62)



Reliable lighting controls use CdS cells 120

One of the most important considerations in the design of control systems for street or highway lighting systems is cost. Studies indicate that costs involved in pilot-wire control of many systems exceed the cost of photoelectric controllers which automatically monitor ambient light levels for optimum switching on or off of the lights. Such studies, of course, must take into account economies which can be realized through reduced burning time.

As far back as 1928 records relate interesting accounts of installations where photoelectric apparatus was used to control the switching on and off of electrical circuits according to the ambient light intensity reaching a sensing device. Technological advances during the past three to four years have made photoelectric lighting controls practical from the point of reliability and economy.

Of all the factors concerned, there is little doubt that development of the cadmium sulphide (CdS) photoconductive cell provided the means for designing a reliable control.

Figure 1 illustrates a plug-in-type CdS control manufactured by CTS of Canada Ltd., Streetsville, Ont. Figure 2 is a block diagram of the control. Power taken directly from the source is varied according to the level of light reaching the CdS cell. The rectified portion of this power is applied to relay coil L to open or close its contacts. With contacts of adequate rating, the lighting load may be controlled directly from that point.

The three common types of outdoor lighting used in Canada are incandescent, mercury vapor and fluorescent. The high inrush currents to a cold incandescent lamp filament impose severe demands on the load contactor. Similarly, with the older mercury vapor systems using unregulated ballasts, inrush currents may be five times higher than the steady state current. Modern ballast-in-head mercury vapor lamps make use of a constant wattage ballast which

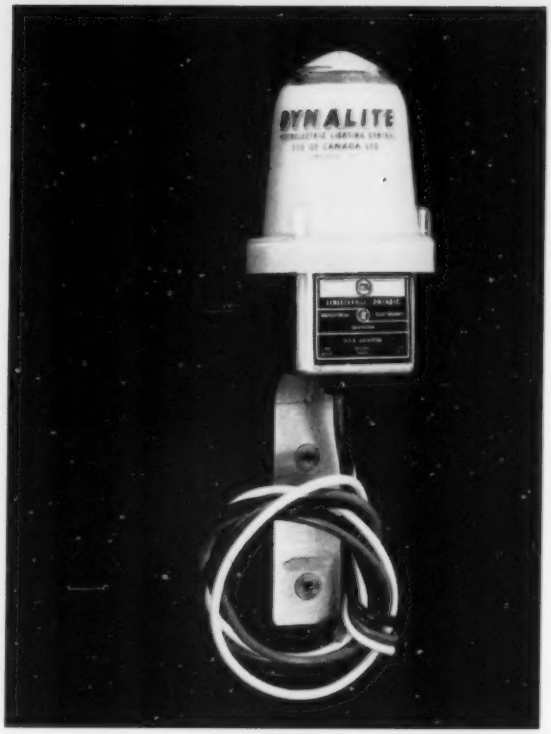


Figure 1.

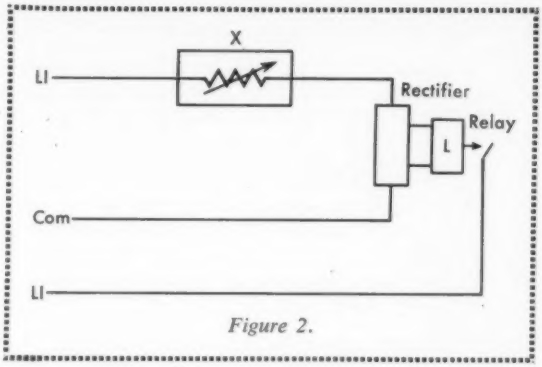


Figure 2.

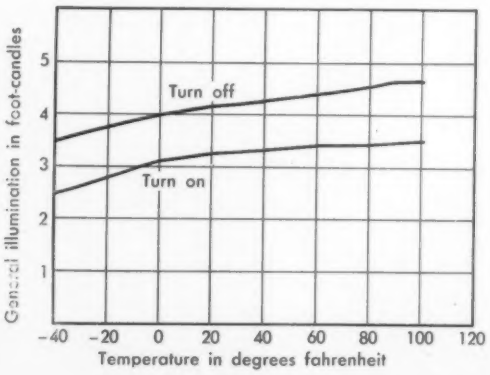


Figure 3.

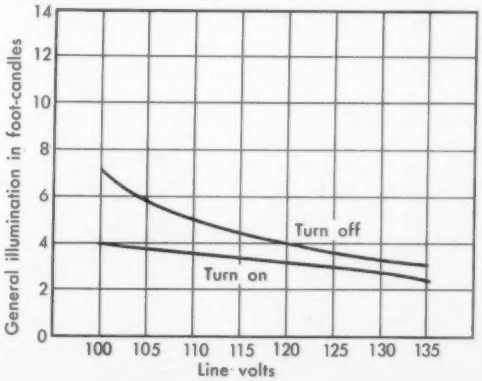


Figure 4.

draws a starting current less than the operating current. With fluorescent lamp ballasts the inrush current exists for only about half a second. However, it may have a very high instantaneous value.

Good lighting control design will generally comply with NEMA-EEI standards for operating light levels; turn on-turn off points; stability over temperature ranges experienced in Canada; change in operating level with line voltage variations. These, and other considerations, are important in meeting the demands of modern lighting services.

Figure 3 illustrates the variation in switching level due to temperature for the CTS Dynalite control. The established factory level is set at 3½ foot candles with an operating differential of one foot candle higher. Figure 4 shows the effect of line voltage variation on the value of light level at which switching occurs. Note the broadening of the turn-on-off characteristics at low line voltage.

Under some conditions a time delay may be desirable to prevent false switching caused by transient light variations. However, the compact CdS controls can usually be mounted high enough, and oriented to prevent interference from extraneous light sources. The duration and intensity of lighting flashes do not produce sufficient average light to actuate the switching mechanism at threshold sensitivity settings above one foot candle.

Air servos adjust heads on magnetic drums 121

Ferranti-Packard Electric Ltd., Toronto, has become one of North America's major manufacturers of magnetic storage drums for computers and communication systems. Recent orders include two large drum systems for International Telephone & Telegraphs as part of a complex global communication system. Each system employs eight 10-in.-diameter drums with a total capacity of 4,500,000 bits. The design of the system is such that the drums are phase-locked employing two electrical windings, one for drive purposes and one for braking. Phase-locking has the effect of providing a common shaft for all drums so that their phase positions are all identical.

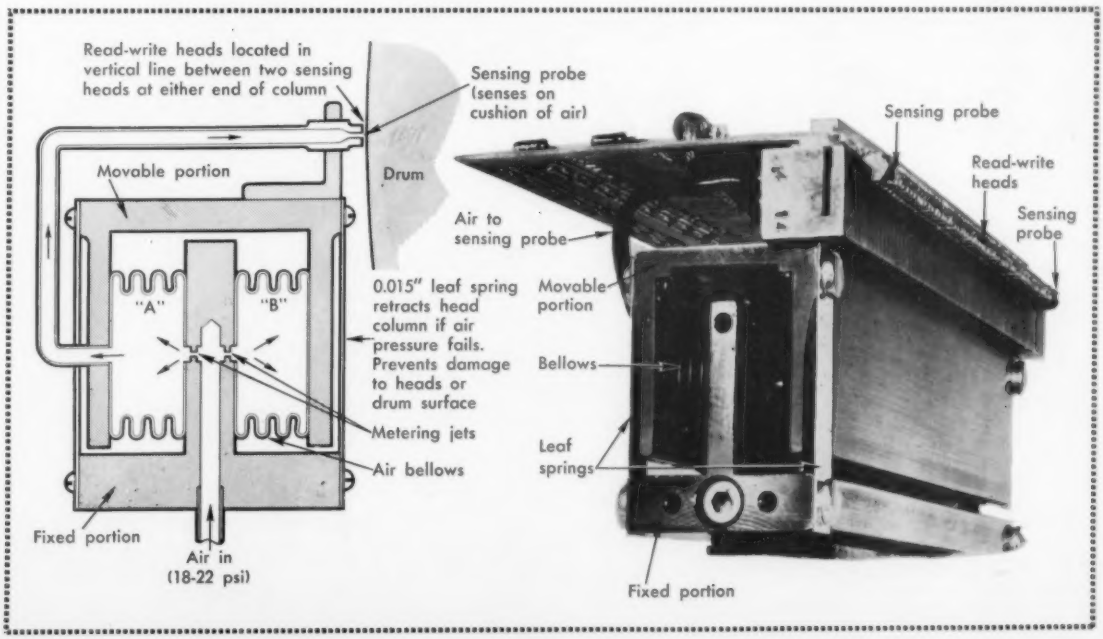
On another order, 17 large drums are being manufactured for Radio Corporation of America as part of the COMLOGNET communications system. These are 18.5 in. diameter, have 512 information tracks with a total capacity of over 5 million bits, and rotate at 900 rpm.

Two important design features have been the main contributing factors in successful operation of the large-size drums. These are air bearings and air servo head columns, the latter being particularly advantageous.

The air bearing is so designed that the drum is supported both laterally and vertically by a thin film of compressed air. Such a bearing has proven to be completely maintenance-free over periods of several years. In the event of air compressor failure, a system of water injection is provided as a protective measure.

The air servo head column is used on larger drums to maintain constant spacing between read-write heads and the surface of the drum in spite of drum dimension changes due to centrifugal and thermal forces. A spacing of approximately 0.0005 in. between heads and drum can be maintained by this system over wide temperature ranges (0—135F) allowing maximum storage capacity per unit area of drum surface.

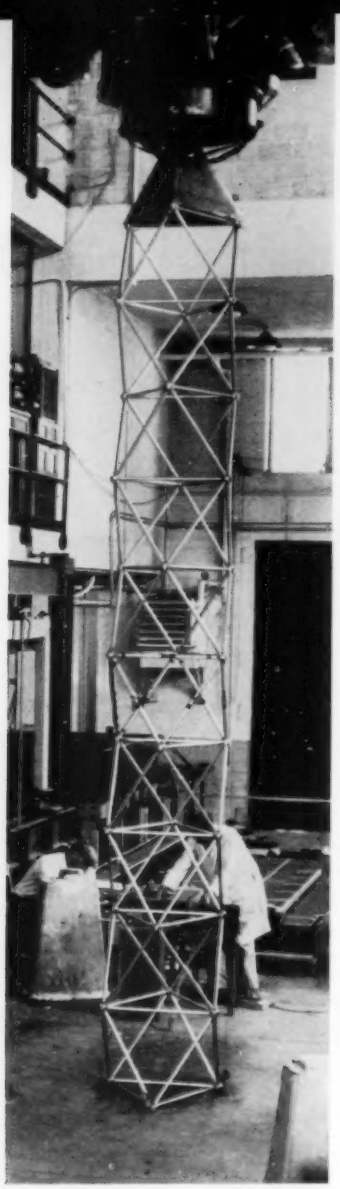
The air servo head column consists of fixed and moving portions connected by small air bellows whose pressure differentials due to expansion or contraction of the drum cause the heads to automatically readjust to maintain the desired spacing. Air servo head columns can be utilized to advantage on all magnetic storage drums over about 10 in. in diameter.



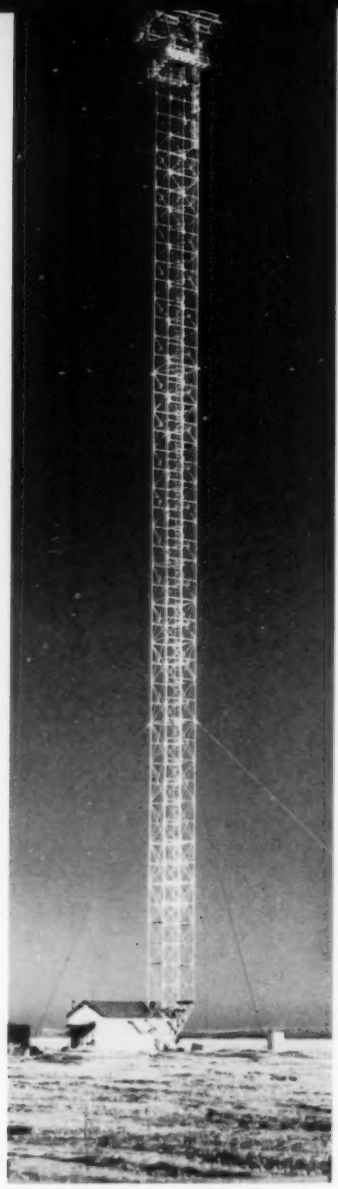
What's new in view

. . of towers, testing and talk-back

A new subdivision in Toronto is claimed to be the first in Canada to offer intercom systems built into the homes. The intercoms, manufactured by Fanon Electronics Ltd., Toronto, each consists of a master control, usually located in the kitchen, and slave units for all other rooms plus front and back doors. The remote units can be used for two-way conversation with the master, as controlled by the latter. There is a built-in radio in the master unit which can be used to provide music to any of the remote units, singly or in various combinations.



Undergoing a rigid test of strength, the recently introduced octahedron tower was shown to have one-third greater load capability and six times greater torsional rigidity than conventional towers. An assembly of octahedral sections, the tower is quickly erected using just two basic parts: ball-shaped joints and identical struts available in aluminum alloy, steel or glassfibre of appropriate lengths, diameters and wall thicknesses for specific requirements. The towers are manufactured by Up-Right Towers, Oshawa. The photograph shows a short tower undergoing compression tests.



Bristol Aero-Industries Ltd., Winnipeg Div. has designed a new tower and antenna "package" for the communications industry. An example is this 350-ft. tower at Elie, Man., forming the main link in the Manitoba Telephone System's proposed heavy route relay between Winnipeg and Portage La Prairie. The tower has been designed to support a total dead load of more than 12,000 pounds, consisting of four cornucopia antennas. Specifications called for maximum deflection of less than ± 1.25 degrees, and maximum twist of less than ± 0.8 degrees. Special guy anchors were developed.

ISA Exhibitors — continued

Automatic Switch Co., Florham Park, N.J.

Aviation Electric Ltd., Montreal.

Bach-Simpson Ltd., London, Ont.
H. A. Leah.
Panel instruments, test equipment and accessories, featuring Controller-Indicator Systems.

Baker Instruments Ltd., Toronto

Beckman Instruments, Inc., Scientific & Process Instruments, Fullerton, Calif.

Bendix Corp., Cincinnati Div., Cincinnati.

Benson-Lehner Corp., Santa Monica, Calif.

Bin-Dicator Co., Detroit.

Black, Sivalls & Bryson, Inc., Kansas City.

The Bristol Co., Waterbury, Conn.

Brooks Instrument Canada Ltd., Scarborough, Ont.

Buchanan Electrical Products Corp., Hillside, N.J.

Budd Instruments Ltd., Toronto.

Budenberg Gauge Co. Ltd., Altrincham, Cheshire, England.

Canadian Charts & Supplies Ltd., Oakville, Ont.

Canadian Controls & Instrumentation (Maclean - Hunter Publishing Co. Ltd.), Toronto.
C. A. King, Harold Price, I. R. Dutton, R. E. Swan.
This is a new Canadian publication with the first issue due November, 1961. It will serve engineers and technicians in the instrumentation and control field across Canada by covering latest developments in mechanical, electrical, electronic, hydraulic and pneumatic systems and equipment.

Canadian Valve Engineering Co., Toronto.

Central Dynamics Ltd., Pointe Claire, Que.

Clary Corp., San Gabriel, Calif.

Cleveland Controls Inc., Cleveland.

Coleman Electronics, Inc., Gardena, Calif.

Computing Devices of Canada Ltd., Ottawa.
J. S. Taylor, W. S. Turner, R. K. Wainwright, A. W. Tracey.
The Bendix Corp., Cincinnati Div.; Clary Corp.; Benson-Lehner Corp.; Electro - Logic Corp.; Coleman Electronics Inc.; Wollensak Optical Co.; Charles A. Hulcher Co.; Hermes Electronics Co.
On display will be Clary printers, Coleman digitizer systems, Electro-Logic digital voltmeters, Fastax and Hulcher high speed motion picture cameras, Hermes 2060 digital display and ultra stable oscillator, Benson-Lehner electroplotter "J", Bendix Lab-Vis†.

Conax Corp., Buffalo.

Conoflow Corp., Philadelphia.

Coulter Industrial Sales Co., Chicago.
S. Kinsman.
Feature of this display will be the Coulter counter† for particle content and size distribution. This year the John Scott award was given to Mr. W. Coulter for his development of the counter.

Crane Limited, Toronto.

Cox Instruments, Div. of George L. Nankervis Co., Detroit.
E. J. Dahn*, R. L. Yung, H. Petzoldt, S. Parker, H. Smith.
Turbine and glass tube flowmeters† for flow rate measuring, recording, controlling, totalizing or telemetering. Auxiliary electronic equipment: digital indicators, totalizers†, analog readouts, frequency converters, strain and temperature digital indicators. Fuel consumption system for gasoline and diesel engines.

Cuno Engineering Corp., Meridan, Conn.

George W. Dahl Co., Inc., Bristol, R.I.
G. W. Dahl, P. Shore.
Air rate indicator, pressure shut-off valve, air rate manifold and by-pass valves for gas-filled communications cables.

D-A-T-A, Continental Technical Service Inc., Dayton, Ohio.

The Data-Master Corp., Glen Cove, N.Y.

Davis Automatic Controls Ltd., Toronto.

Daystrom Ltd., Cooksville, Ont.

Eagle Signal Co., Moline, Ill.

Ekco Electronics Ltd., Southend-on-Sea, Essex, England.

Electro-Logic Corp., Vanice, Calif.

Electronics and Communications, (Age Publications Ltd.), Toronto.
T. W. Lazenby, R. C. Poulter, H. E. (Bud) Dallyn, D. Reynolds, R. Wood.
Electronics and Communications magazine—Canada's pioneer Journal in the field of electronics and communications engineering.

The Electronics Corp. of America (Canada) Ltd., Toronto.

Emcor Ingersoll Products Div. of Borg-Warner, Corp., Elgin, Ill.
J. M. Votava, C. W. Peterson.
Steel modular enclosure cabinets for electronic communications and instrumentation industry. Lift lid work writing top†; "Slide-slim" chassis slides†; light fixture†; Wire mould plug-in strips†; Aluminum panels†.

Epsylon Industries Ltd., Feltham, Middlesex, England.

Esna, Canada Ltd., Toronto.
Frank Complin, Peter Tyler, Brink Weaver, Al. Taylor.
Buchanan Electrical Products Corp.; Agastat Timing Div. of Esna.
Components, equipment or services to be exhibited include Agastat time delay relays (conventional and solid state); Buchanan terminal blocks (sectional and one-piece), crimp connectors (pre-insulated and others).

F & M Scientific Corp., New Castle, Delaware.

Fischer & Porter (Canada) Ltd., Toronto.
D. A. McCammon*, H. C. Allan, J. R. Kent, R. Harris.
Fischer & Porter (Canada) Ltd.; Kimble Glass Co.; Uniflow Valve Co.
Exhibit will include magnetic flow meter, variable area meter†, variable head meter, plastic case temperature and pressure transmitter and controller, miniature and large case pneumatic receiver recorder controller, 3400 series chlorinator†, Kimble glass pipe and fittings, turbine-type flowmeter.

Fisher Governor Co., Marshalltown, Iowa.

The Foxboro Co. Ltd., Montreal.
R. W. Maskell, W. F. Wright, C. McEwen, D. L. Brown, D. W. Stubley, F. F. Shonkwiler, A. Grant, C. N. McPherson, R. Hosmer, R. R. Rice, D. C. Barta.
Analog computing instruments: an M/46D pneumatic computer, M/64 indicating integrator, square root converter, type 66D multiplier-divider, 6-in. dial type indicators. Electronic Consotrol instruments: type 613 d/p cell transmitter, type 631 indicating pressure transmitter, type 611 F/B pressure transmitter, type EMF current converter, and a console. A new instrument is type 19A pneumatic current transmitter†.

The Gems Co., Inc., Farmington, Conn.

General Electric Co., Schenectady, N.Y.
R. P. Carroll, H. S. Day*, F. E. Graf*, A. H. Kaufman, C. A. Mons.
Industrial mass flowmeter; analog and digital telemetering equipment†; round-chart and strip-chart recorders; animated backwall panels which photographically display GE instrumentation for industrial power generation, fluid blending and accounting, thermal processes, feed-speed process lines, leak-sensing and vacuum controls.

Gow-Mac Instrument Co., Madison, N.J.

W.&L.E. Gurley, Troy, N.Y.

Hagan Chemical & Controls Inc., Pittsburgh.

Hagan Corp. (Canada) Ltd., Toronto.

Helicoid Gage Div., American Chain & Cable Co., Inc., Bridgeport, Conn.

Honeywell Controls Ltd., Toronto.
W. H. Evans, N. K. Smith, G. H. Sedgley, J. H. Fox, G. H. Macdonald, H. M. Marks and others.
ElectroniK 17 strip chart and circular chart recorders and controllers; ElectroniK 15 strip chart recorder; New indicating and non-indicating pneumatic temperature transmitters; Bellows indicating flow transmitter; Tel-O-Set recording control station; Pressure-to-temperature transducer; Millivolts-to-current transducer; Versa-Tran controllers; 1108 Visicorder.

Huron Valve & Fitting Co., Sarnia, Ont.

Imperial-Eastman Corp., Chicago.

Instronics Ltd., Stittsville, Ont.

Jerguson Gage & Valve Co., Burlington, Mass.

W. A. Kates Co., Deerfield, Ill.

George Kent (Canada) Ltd., Toronto.

Kirk Equipment Ltd., Montreal.

Leslie Co., Lyndhurst, N.J.

Laurentian Valve & Fitting Co., Montreal.

Magnetic Instruments Inc., Thornwood, N.Y.

Manning, Maxwell & Moore of Canada Ltd., Galt, Ont.

Marsh Instrument Co., Skokie, Ill.
Maurice Minton*.
Featured in the display will be gauges, thermometers and valves.

Mason-Neilan, Div. of Worthington Canada Ltd., Toronto.

Measurement Engineering Ltd., Arnprior, Ont.
D. A. Bamford, R. Staye, P. Steen, C. E. Ohlheiser, J. Schutz.
Measurement Engineering Ltd.; Fielden Electronics Ltd.; Elliott Bros. (London) Ltd.; Goring Kerr Ltd.; Hygrodynamics Inc.; Powertronics Inc.; Princo Inc.; Boekels & Co.; Erie Pacific Inc.; Instrument Development Lab. Inc.
On display will be level indicators and controls; temperature indicators and controls; circular chart recorders; humidity indicators and controls; electric weighing equipment; tramp metal detectors; ultrasonic cleaners; high-speed counters; color analyzers; density controls; slip monitors† for grain elevator belt control; Hycon testers† for analysis of gas content in molten aluminum.

The Mercoid Corp., Chicago.

Meriam Instrument Co., Cleveland.

Milton Roy Co., Philadelphia.
Robert T. Sheen*, John A Mitchell*, James F. Baird*, Dr. Earl J. Serfass*.
Equipment displayed will include a chromatographic minipump; chromatographic hydrogen purifier; C-15 hydrogen purifier; Chemalyzer automatic colorimetric analyzer; Versa-Vac vacuum-pressure pump in one unit; Milroyal† low flow metering pump with accuracy with ±1% and ability to adjust capacity during operation.

Mine Safety Appliances Co. of Canada Ltd., Toronto.

Moore Instrument Co. Ltd., Toronto.

Moore Products Co., Philadelphia.

Negretti & Zambra (Canada) Ltd., Toronto.

Niagara Valve & Fitting Co., Hamilton.

OPW—Jordan Corp., Cincinnati.

Offner Electronics Inc., Schiller Park, Ill.

Ontor Ltd., Toronto.

Orenda Industrial Ltd., Toronto.
W. E. Rowan and others.
Precision, instrument, pitot, pitot-static probes; precision push-button potentiometer; engineering services specializiing in systems design, repair and calibration of instrumentation; also metallurgical and chemical engineering.

Palmer Thermometers, Inc., Cincinnati.

Petrometer Corp., Long Island City, N.Y.

Panellit, a Div. of ISI, Inc., Skokie, Ill.
G. P. Mitchell*, A. L. Wombacher*, R. W. Choronzy*.
Panalarm DS-6 digital sequential annunciator; Panalarm VS visual sequence annunciator; Panalarm recording annunciator; Panalarm model 3133† solid state, sequence LAC annunciator having full voltage of 125 vdc; annunciator window bezel†, tilted to offer better visibility with slide-out nameplates.

Peackock Bros. Ltd., LaSalle, Que.

Process Instrument Systems, Toronto.

R-O-R Associates Ltd., Don Mills, Ont.
J. S. Root, E. J. Wootten, R. Wood, W. Mainguy, W. McLellan, W. Hastings.
Baldwin-Lime-Hamilton Corp.; Sanborn Co.; F. L. Mosley Co.; Berkley Div., Beckman Instruments, Inc.; Bruel & Kjaer; Hughes Aircraft Co.
Exhibit will include load cells; pressure cells; weighing systems; graphic recorders of all types (10 in. and 6 in. strip chart units, high-speed direct writers and optical recorders); Hughes infinite persistence oscilloscope†; optical line follower to obtain voltage outputs from recorded charts; digital reversing electronic counter†; precision sound level meter†.

Radiation Electronics Co., Chicago.

Radionics Ltd., Montreal.
George G. Beyrouty, Edward S. Zieba, W. Bouldin (Westronics), R. J. Levine (Magnetic Instr. Co.).
Westronics Inc.; Magnetic Instruments Co. Inc.; Analab Instrument Corp.
DC amplifier; capacitance level gauges for continuous indication; differential capacitance level switches†; thermocouple amplifiers; Analab dual trace oscilloscopes with plug-in units; Westronics miniature multipoint recorder†, microvolt input module†, null balance potentiometers and other strip chart recorders.

Research Controls, Inc., Tulsa, Oklahoma.
Roy Horton*, G. A. Rice*.
Miniature air motor operated diaphragm valves, primarily designed for the purpose of automatically controlling low flows on the order of cc's per minute, full floating proportional control from pneumatic or electrical output signal controllers. Electro pneumatic receiving positioning relay for receiving 0 to 5 ma current signals, transducing for operation proportionately and modulating flows through tubing or pipe line.

Rotron Controls Corp., Woodstock, N.Y.

Schutte & Koerting Co., Cornwells Heights, Pa.

Serfass Corp., St. Petersburgh, Fla.

Sioc Ltd., Toronto.
Keith S. Boorman*, Jim. MacDonald, John Genge.
On display will be Scam annunciator systems and components, including a new recording annunciator.

Smyth Electronic Components Ltd., Montreal.

Sperry Gyroscope (Ottawa) Ltd., Ottawa.

Stone Instrument & Supply Co., Houston, Texas.

The Superior Electric Co., Bristol, Conn.

Taylor Instrument Companies, Rochester, N.Y.

Taylor Instrument Co. of Canada, Toronto.

Technical Oil Tool Corp., Los Angeles.

Tektronix Inc., Willowdale, Ont.
Dale Brous, Bill Kladke, Marvin Crouch, Gordon Dickson, Udo Lindenmeyer, Ray Lisiecki, Dick Zahn.
Oscilloscopes and accessories featuring an angular transducer and strain gauge bridge. Operational amplifier O plug-in†, and oscilloscope camera C-12† are new items being introduced to the market.

Thermo Electric (Canada) Ltd., Brampton, Ont.
G. S. Martin*, J. Kavanagh*, R. F. Birchall*.
Temperature measuring, recording, indicating, monitoring and control equipment with associated accessories such as thermocouples, thermocouple wire, connectors, panels, thermowells, resistance bulbs, selector switches and other parts. New equipment being introduced are a ten-point multi-point controller† for temperature, and a temperature monitoring system.

Thermovolt Instruments Ltd., Toronto.

Transistor Specialties, Plainsview, L.I., N.Y.

U.S. Gauge Div., American Machine & Metals, Sellersville, Pa.

United Electronic Controls (Canada) Ltd., Dorval, P.Q.
Lorne J. Inglis*, Leo Ricci, George W. Clapp*, Roy Chamberlin.
On exhibit will be a comprehensive range of electric temperature, pressure and vacuum controls. These include skeleton, enclosed, multi-switch, indicating, recording and explosion-proof controls, thermostats, etc. Being introduced are a temperature recorder-controller† and a high temperature indicating temperature control†.

Vapor Recovery Systems, Compton, Calif.

Wallace & Teirnan Inc., Belleville, N.J.

West Instrument Corp., Chicago.

Westronics Inc., Fort Worth, Texas.

S. S. White Industrial Div., New York.

Wollensak Optical Co., Rochester.

York Valve & Fitting Ltd., Concord, Ont.

Canadian Controls & Instrumentation will be at Booth 135

See these at the ISA show

Latest developments will be on display

Pulse-to-step data converter 101

A new pulse-to-step converter called Slo-Syn Translator Type ST-150 is now available for use in programmed positioning, remote positioning, indexing and indicating applications. The device is designed to convert low level signal pulses or square waves into the correct switching sequence needed to drive a Slo-Syn Synchronous Motor at 200 discrete steps per revolution. Speeds up to 225 or 400 steps per second are possible depending on the motor used. Commands originate from information stored on magnetic or punched tape or from some other type of pulse generator. For each element of stimulus, the motor output shaft advances to a new angular position. Power input to the Slo-Syn Translator is 120 vac, 0.5 amperes; signal input impedance is 1,000 ohms with a minimum voltage change of 1.5 volts. The input may be triggered by either pulse or square wave or by an external switch.

The American Superior Electric Co. Ltd., Toronto.

Mercury-wetted contact relay 102

Series V51 (mercury-wetted contact) relays have been designed for high-speed operation in computers, data processing and control equipment. A hermetically sealed glass capsule encloses the contact assembly and a small pool of mercury in a pressurized atmosphere. Life expectancy is over 1 billion operations without change, maintenance or adjustment. Operating speed is up to 100 operations per second maximum. Operate time is approximately 3 milliseconds with coil input of 2 watts; operate sensitivity is 250 milliwatts minimum. Coils for the Series V51 relay may be single or concentric double wound. They must operate at 190 ampere-turns; non-operate at 124 ampere-turns; hold at 147 ampere-turns; release at 84 ampere-turns.

Automatic Electric Sales (Canada) Ltd., Toronto.

Laboratory viscosity instrument 103

Bendix Lab-Vis has been designed to make laboratory viscosity measurements. It has eight ranges 0-10/50/100/500/1,000/5,000/10,000/50,000 centipoises. Sensing element operation is up to 650 deg. F. and 1,000 psi. A continuous record is provided on a strip chart recorder with 11 in. viscosity scale. Chart speeds of 1, 20, 30 and 40 inches per hour are provided. Accuracy is better than ± 1% full scale for Newtonian liquids with reproducibility better than ± 1%.

Computing Devices of Canada Ltd., Ottawa.

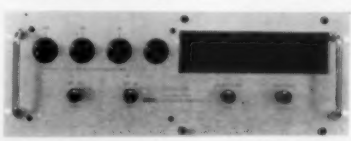
Particle content counter 104

The Coulter Counter determines the number and size of particles suspended in an electrically conductive liquid. The suspension flows through a small aperture having an immersed electrode on either side, with particle concentration such that the particles traverse the aperture substantially one at a time. Each particle passage displaces electrolyte within the aperture, momentarily changing the resistance between the electrodes and producing a voltage pulse of magnitude proportional to particle volume. The resultant series of pulses is electronically amplified, scaled and counted.

Coulter Industrial Sales Co., Chicago.

Transistorized pulse totalizer 105

Transistorized pulse totalizer model 843, with six-digit (to 999,999) nixie readout and four-digit preset accumulator is designed for flow totalizing applications using turbine flowmeters in pipelines, refineries or petro-chemical processes. It performs two separate functions: totalizing volume using a preset accumulator and totalizing input pulses.



Cox Instruments Div., Detroit.

Chassis slides 106

"Slim-Slide" has been designed to fit 1¾ in. panels (and up) and may be flush mounted against enclosure skin of air flow panel. The slides are available in shelf type, front rail type, stop-lock or roto - lock types in eleven stock lengths from 10 to 30 in.

Emcor Ingersoll Products, Chicago.

Rotameter 107

Magnarator indicating and transmitting rotameter is a pneumatic transmitter magnetically coupled to, and integrally mounted with, a variable-area meter. It combines the functions of flow measurement, indication and transmission in a single composite unit. The transmitting element can be used with any metering tube and float combination from ½ to 2 in. connections, covering maximum flows equivalent to 1 to 100 gpm water and 4 to 400 scfm air.

Fischer & Porter (Canada) Ltd., Toronto.

Chlorinator 108

Controlomatic chlorinator, series 3400, is adaptable to manual, program or automatic control. Feed rate may be controlled by vacuum, pneumatic or electrical signals from any type flowmeter or chlorine residual analyzer. Vacuum operation of the chlorinator and positive-acting chlorine gas shut-off valve ensure safety of operating personnel and plant equipment. Flowmeter standard maximum capacities are 3, 10, 20, 40, 50, 75, 100, 200, 250, 300, 400, 500, 700, 1,000, 1,500 and 2,000 pounds per 24 hours. Flowmeter rangeability is 20:1 per flowmeter.

Fischer & Porter (Canada) Ltd., Toronto.

(Continued on page 68)

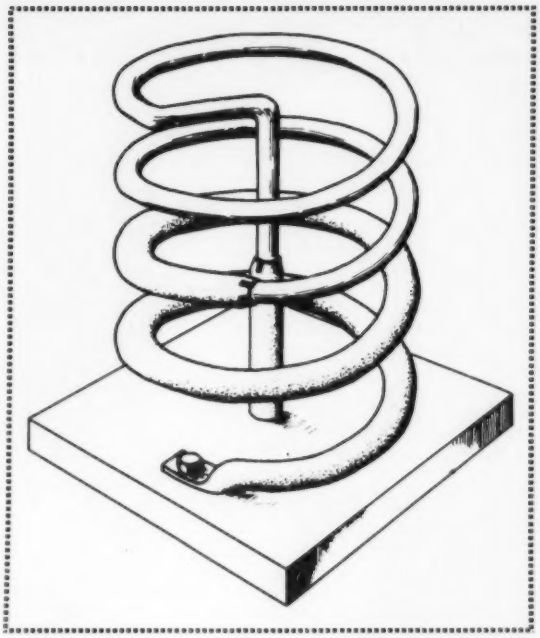
To obtain additional information about these products, use the Reader Service cards on page 75.

Adjustable helical inductance

Case No. 1314

Inventor: Arthur C. Hudson

This invention originated in the laboratories of the Division of Radio and Electrical Engineering, National Research Council, Ottawa, and relates to an adjustable helically wound coil such as may be used in the high frequency circuits of electronic apparatus. It is patented in Canada, U.S.A. and Australia.



There are two usual methods of adjusting a physically large industance such as the tank circuit of a radio transmitter or of an induction heating oscillator. One method is to employ an adjustable tap for one connection to the coil; or alternatively, an adjustable connection may be used to short-circuit some of the turns at one end of the coil. Both of these methods have disadvantages associated with currents flowing in the unused portion of the coil. These disadvantages include extra losses and spurious resonances due to the stray capacitance of the unused portion of the coil.

In the new design illustrated in the drawing, the disadvantages of the prior art are overcome by having the coil divided into two sections of conductor having the same winding pitch and diameter and arranged on a common axis. The unused portion of the coil causes no electrical difficulties because it screws into the fixed portion. The electrical capacitance between the inner and outer conductors and also the tendency of currents at radio frequencies to flow near the surface of conductors ensure that current on the unused section of the coil will have no effect.

The best type of sliding contacts will depend on the details of the particular application. Possible methods include spring fingers, rollers, set screws, or even soldering in cases where frequent adjustment is not required. The capacitance between the inner and outer conductors is in parallel with the contact resistance and thus reduces the current at the contact.

The best mechanical method of driving the adjustable section of the coil will also depend on the details of the application. One method is to make the axial section of the adjustable part of the coil sufficiently rigid to serve as a driving shaft. END

People—continued

William H. Jenkins has been appointed sales technical manager of Burroughs Business Machines Ltd.

In his new position, Mr. Jenkins will be responsible for supervising and training the company's sales technical representatives in Toronto, Montreal, Ottawa and Calgary. Mr. Jenkins, a graduate of Queen's University, joined Burroughs in 1957 as a sales technical representative. In September 1960 he was made supervisor of technical services, the position he held at the time of his promotion. Prior to joining Burroughs, Mr. Jenkins was employed by Avro Aircraft Ltd. and Computing Devices of Canada Ltd.

L. A. Bown has been appointed Ottawa resident manager of the Government and Industrial Division, Philco Corp. of Canada Ltd.

Mr. Bown served 22 years with the Royal Canadian Navy, retiring with the rank of commander. His last appointment was as electrical officer, RCN Air Station, Shearwater, N.S.

Ryan

Bown

L. Patrick Ryan, P.Eng., has been appointed to the permanent staff of the Association of Professional Engineers of Ontario.

Mr. Ryan's duties will include the formation of a system of association chapters throughout the province as a means of improving communications among APEO members.

Canadian National Telecommunications has appointed Donald E. Ashdown as personnel supervisor in the engineering department.

Born in Lima, Peru, of Canadian parents, Mr. Ashdown came to Canada in 1944. He received his BA degree from Queen's University and has taken post-graduate work in industrial relations. Prior to his CNT appointment, Mr. Ashdown was with the personnel department of Honeywell Controls Ltd., Toronto.

Robert A. Emerson has been elected a director of the Consolidated Mining and Smelting Co. of Canada Ltd.

Mr. Emerson is a vice-president and member of the executive committee of the board of directors of the Canadian Pacific Railway Co. He is a member of the Engineering Institute of Canada, Corporation of Professional Engineers, Quebec and the American Railway Engineering Association.

Reports—continued

New representative in Edmonton

A new company, **T. B. A. Scientific Supplies,** has been established with offices at 9107-120th St., Edmonton. Firms represented include **Electrograph,** also of Edmonton (custom decade counters and scalers); **Kyowa Electronic Instrument Co. Ltd.,** Tokyo, Japan (strain gauges, load cells and associated instrumentation); **Shimadzu Science Supply,** also of Japan (electron microscopes, spectrometers, etc.).

Sperry Gyroscope gets $625,000 contract

A contract totalling more than $625,000 to carry out tuning and testing of electronic equipment has been awarded to Sperry Gyroscope Co. of Canada Ltd., Montreal. The equipment is on the six new destroyer escorts of the 261 Mackenzie class now being built in Canada for the RCN and includes sonar, weapon control, communications and radar systems, some of which was manufactured by Sperry.

Garrett Mfg. to produce field test equipment

A $500,000 contract to develop and manufacture field test equipment for their CF-104 central air data computing systems has been received by Garrett Mfg. Ltd., Toronto. The test units will be portable for flight line use, and will combine laboratory accuracy with rugged all-weather capability.

Production work has already begun on the air data systems (see CEE, March 1961, p. 9). These units sense atmospheric environment relative to the aircraft in flight and convert various factors into vital flight intelligence data.

DDP orders U.K. test equipment

Marconi Instruments Ltd. of St. Albans, England, through its agents in Canada—Canadian Marconi Co., Montreal — has received contracts from the Department of Defence Production for approximately $160,000 worth of signal generators. Deliveries of the instruments, which will be used by the RCAF in the maintenance of communications equipment, have already commenced.

Bach-Simpson and Welwyn Canada add to plant and offices

The addition of a modern two-storey office and a three-storey factory expansion at the rear of the present London, Ont. facilities of Bach-Simpson Ltd. and Welwyn Canada Ltd. marks the end of the first phase of a continuous building program carried out by the sister companies over the past ten years. During this period the total floor area has grown from approximately 5,000 sq ft to 40,000.

The newly - commissioned offices serve as headquarters for the two Canadian companies and for their wholly-owned American subsidiaries, The London Company and Welwyn International Inc. The additional factory space will consolidate and expand both manufacturing and service facilities. The latter will include a new $100,000 environmental laboratory for testing the products of both companies to the latest military specifications.

BBG announces schedule for 1961 hearings

The Board of Broadcast Governors has announced that it will hold public hearings in Ottawa commencing on the following dates in 1961: April 11, June 20, August 22, October 17, and November 28. The applications to be heard will be listed in the Canada Gazette and details of time, place, etc. will be sent to interested parties in advance of each hearing.

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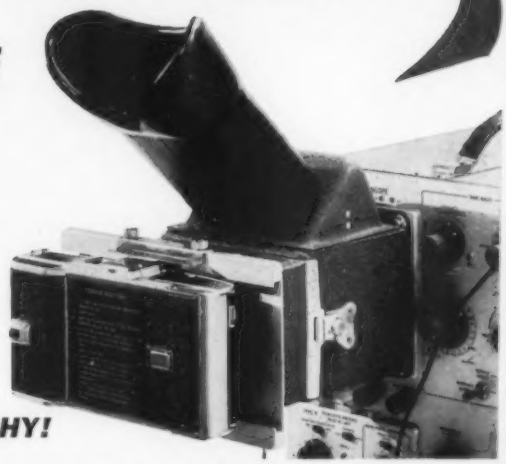

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EIC meeting will have session on automatic control

Two sessions on automatic control will be included in the technical program for the 75th annual meeting of the Engineering Institute of Canada, Vancouver, May 31, June 1-2. They have been organized in co-operation with the National Research Council, Associate Committee on Automatic Control.

Both sessions are scheduled for Thursday, June 1. Papers to be given are:

The optimization of the performance of an ore bridge, an analog computer study, by J. A. Field.

The determination of linear multivariable models for complex processes, by R. J. Kavanagh.

Economic performance criteria for optimizing control systems, by J. H. Milsum.

A continuously acting adaptive analog computer for determining the impulse response of control systems with Gaussian signals, by E. V. Bohn.

The control system of an automatic stereo mapping machine, by J. M. Ham and G. L. Hobrough.

Process loop optimization through valve characterization techniques, by G. L. d'Ombrain and S. M. Lyle.

The optimal gain of manually controlled machines, by C. B. Gibbs.

Reliable networks from unreliable components, by Miss O. Boshko, G. S. Glinski and J. Therrien.

Two other sessions that will be of interest to electronics engineers are Electrical I, Wednesday, May 31, and Electrical II, Friday, June 2.

Papers for these sessions are:

Electronic aids in Canadian mapping, by J. T. Henderson.

The Defence Research Board Topside Sounder satellite, by R. C. Langille.

Design considerations for large radio telescopes, by J. L. Locke.

New uses for ceramic materials in microwave tubes, by G. B. Walker.

Rearward communications for BMEWS, by L. J. Hammerschmidt.

Some problems encountered in underwater sound propagation, by H. H. A. Davidson.

Canadian Nuclear Association meeting

From 250 to 300 businessmen, scientists, mining executives, educators and government officials from Canada, United States, Britain and Europe are expected to attend the first annual meeting and conference of the Canadian Nuclear Association which will be held in the Lord Simcoe Hotel, Toronto, May 16 and 17. The conference is to study and discuss the problems and future plans of the billion-dollar nuclear industry in Canada. Theme of the conference is "Forward with the Atom."

Hagan Corp. wins contract for controls

Hagan Corporation Limited has been awarded a contract by the Hydro Electric Power Commission of Ontario to furnish its PowrMag magnetic controls for units three and four at the Lakeview generating station.

Included in the contract are combustion, feedwater and steam temperature controls. All are PowrMag systems with miniature recorders.

The Lakeview station, being built along the shores of Lake Ontario, will be one of the world's largest thermal-electric plants with a planned output of 1,800 megawatts.

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IRE Sections in Canada elect new executive for next season

With the end of another season approaching, many IRE Sections across Canada have held their annual elections, or will do so within the next few weeks.

Kitchener-Waterloo Section has elected the following officers: B. S. McConachie, Raytheon Canada Ltd. as chairman; Dr. B. R. Myers, University of Waterloo, as vice chairman; W. J. Gray, Raytheon Canada Ltd., as secretary-treasurer.

In Toronto G. T. Quigley, Philips Electronics Industries Ltd. has been elected chairman; W. H. Anderson, Ryerson Institute of Technology has been elected vice chairman; F. A. Ford, Canadian General Electric Co. Ltd., has been elected secretary-treasurer.

Ottawa Section will hold elections May 19, and the slate submitted by the nominating committee is: W. R. Conway, chairman; A. R. Molozzi, vice chairman; S. G. Jones, secretary-treasurer.

The May 19 meeting will be the last of the season for the Ottawa Section. Members from the Syracuse IRE Section will visit establishments in the Ottawa area during the day, then join with the Ottawa members for their Annual Meeting and Ladies Night. Dr. Hugh LeCaine, National Research Council, will present a talk and demonstration "The tape recorder as a tool in the electronic studio."

News about elections in other Sections will be published as soon as information can be obtained.

Conference advisory committee

Last month we introduced two members of the IRE Canadian Electronics Conference advisory committee. Here are some more members.

Boyd

Annis

Air Vice-Marshall C. L. Annis, O.B.E., C.D., is Air Officer Commanding, Air Materiel Command, Department of National Defence.

David Boyd is President of the Canadian Aeronautical Institute.

Ottawa forms PGMIL Chapter

During February, the IRE Executive Committee approved an application by the Ottawa Section members to form a local Chapter of the Professional Group on Military Electronics.

A charter meeting was held at the National Research Council auditorium April 27 at which Dr. G. Miller, NRC, was named chairman of the Chapter.

National Chairman of PGMIL, Edward G. Witting, attended the charter meeting in Ottawa. Mr. Witting is Deputy Director, R&D, Department of the Army, Washington.

A number of visitors from the Rome, New York, PGMIL Chapter also attended the Ottawa meeting, and stayed over for a tour of the city the following day.

All New Hughes 10 mc MEMO-SCOPE® Oscilloscope

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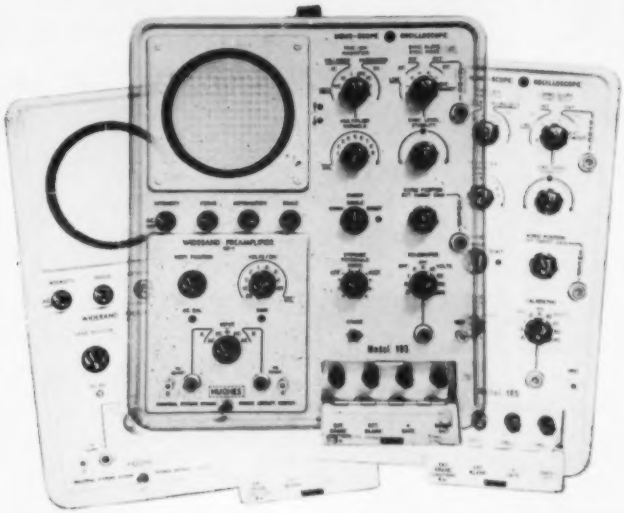

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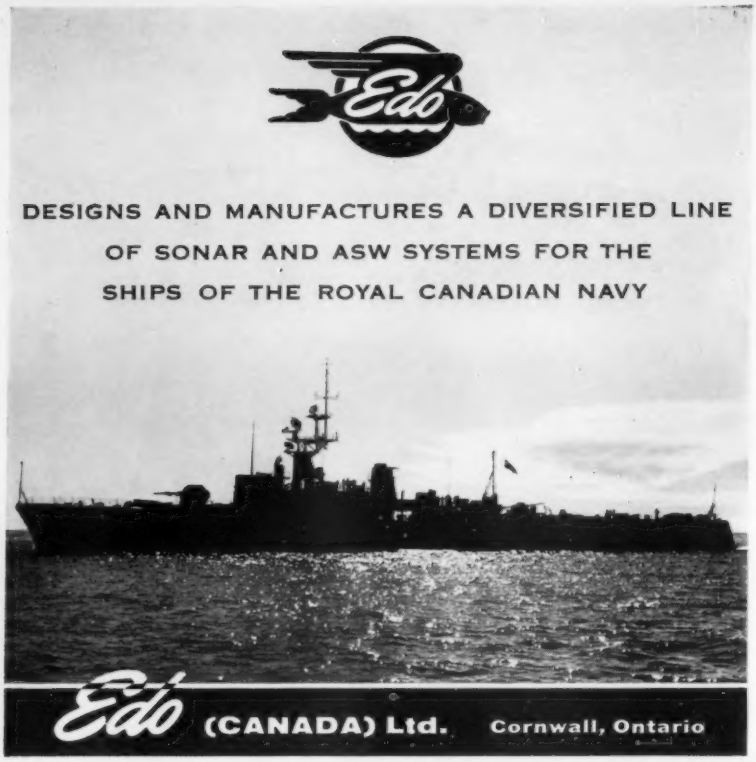
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Defence contracts

Unclassified electronics contracts for $10,000 or more have been awarded to the following Canadian firms by the Department of Defence Production. A figure in parentheses indicates the number of contracts, the amount being the total value.

March 1-15, 1961

- Canadian General Electric Co. Ltd., Toronto, components, $32,808; technical publications, $74,956; technical representatives, $95,990.
- Canadian Westinghouse Co. Ltd., Ottawa, tubes, $19,244.
- Cannon Electric Canada Ltd., Toronto, connectors, $11,856.
- E.M.I.-Cossor Electronics Ltd., Dartmouth, N.S., sonobuoys, $463,881.
- Electromechanical Products, Agincourt, Ont., amplifiers, $10,890.
- Electronic Materials International Ltd. Ottawa, amplifiers, $34,810.
- Garrett Mfg. Ltd., Rexdale, Ont., equipment, $554,071.
- Instronics Ltd., Stittsville, Ont., radar test sets, $42,217; radio reception equipment, $243,282 (2).
- McBee Co. Ltd., Toronto, digital computer, $18,000.
- Northern Radio Mfg. Co. Ltd., Ottawa, multiplex telegraph terminal, $12,722.
- Presentey Engineering Products Ltd., Ottawa, engineering services, $10,000.
- Pye Canada Ltd., Toronto, radio transmitters, $16,533.
- Valeriote Electronics (Guelph) Ltd., Guelph, Ont., modification kits for radio transmitters, $22,261.

March 16-31, 1961

- Alpha Aracon Radio Co. Ltd., Downsview, Ont., aircraft electrical components, $17,239.
- Bayly Engineering Ltd., Ottawa, power meters, $28,575; impedance-angle meters, $28,835.
- Canadian Aviation Electronics Ltd., Montreal, equipment, $14,518.
- Canadian General Electric Co. Ltd., Toronto, installation of equipment, $13,507; tubes, $67,067; renovation of antennas and transmission lines, $70,600.
- Canadian Marconi Co., Toronto, tubes, $53,618.
- Canadian Westinghouse Co. Ltd., Hamilton, technical publications, $44,771.
- Collins Radio Co. of Canada Ltd., Toronto, antenna spares, $14,944; antenna and control system, $22,659.
- Instronics Ltd., Stittsville, Ont., equipment, $326,971 (2).
- Marsland Engineering Ltd., Kitchener, Ont., main support spares for explosives echo ranging recorders, $45,894.
- Needco Cooling Semiconductors Ltd., Montreal, development contract, $23,467.
- Northern Electric Co. Ltd., Ottawa, components, $11,375.
- Premier Metal Housings Ltd., Montreal, cabinets for electronic equipment, $13,210.
- RCA Victor Co. Ltd., Montreal, tubes, $22,987.
- R-O-R Associates Ltd., Don Mills, Ont., tubes, $99,287.

- Raytheon Canada Ltd., Ottawa, tubes, $149,417.
- Sperry Gyroscope Co. of Canada Ltd., Montreal, modification kits for compass, $10,399; development contract, $16,018; components, $21,074.
- Sylvania Electric (Canada) Ltd., Montreal, tubes, $72,717.

CAMESA News

This bulletin has been prepared for CEE by the Approvals and Specifications Divisions, Canadian Military Electronics Standards Agency, Ottawa.

- **Approval of Canadian part manufacturers.** During the month of March the products of 5 Canadian part manufacturers were qualified under MIL specifications by U. S. qualification authorities and these products are now listed on U. S. Qualified Products Lists. Since the reciprocal approval program with the U. S. was initiated in 1958, the products of 13 Canadian manufacturers have appeared on U. S. Qualified Products Lists. These listings cover 306 types or items, the majority of which are in the area of wire and cable.

- A new specification, **MIL-B-5423B,** covering boots designed to prevent the ingress of dust and water into switches and rotary actuated parts has recently been issued. Associated with this specification are nine detail specifications covering the individual types and styles of boots, which are of molded silicone-rubber construction. Specification MIL-B-5423B supersedes MIL-B-005423(ASG) and MIL-B-19257(SHIPS).

- Canadian Specification Sheet **CSS-56** covering collet type control knobs has been adopted by the Canadian Army. There are three basic knob styles with variations which include skirts, size and the choice of ⅛ and ¼ inch shaft diameters. Specification MIL-K-3926 is referenced as a subsidiary document.

- Specification **MIL-C-26500(USAF)** has been adopted by the Canadian Armed Forces. This specification covers the general requirements for miniature general purpose connectors designed to resist the type of environment encountered in missile applications. The connectors are essentially voidless and are intended for application in ambient temperatures up to 200°C. Detail requirements for individual styles will be covered by Military Standards (MS Sheets), to be issued at a later date.

Should auld acquaintance be forgot?

Except for depressions, floods and famines, the sales of one of our real old-timers have been booming every year since its introduction in 1944. The whole thing got started when we were requested to build a precision DC relay for floating mines that would surely work after it and the mine had been dropped out of an airplane. We tried, and the relay worked — until the mine went off. After the smoke cleared, and small, long-lived rectifiers and diodes came along, an AC version was hatched. Seventeen years later, it's no surprise (to us, at least) that 34 standard variations have successfully found their way into customers' circuits.

This acme of perfection, reliability and joy to the Management's heart is the Series 5, which is used in either AC or DC circuits to provide: release and operate points very close together; break delay; constant operate voltage despite wide temperature variation; dual coils for differential operation; or meter protection from DC voltage or current overloads. The "5" can operate on as little as 1 mw., contacts will switch up to 3 amps (depending on sensitivity), and available enclosures range from none to hermetically sealed.

The Series 5 relay is now widely used in burglar alarms, coin-operated arcade games, temperature monitoring controls with Sigma Magnetic Amplifier Relays, boiler water salinity controls, battery chargers and R/C models, as well as in G.I. equipment. The reasons are probably (1) its combination of high sensitivity and stability in hard-knock applications, (2) the "special" characteristics you can get, usually at non-special prices, and (3) the fact that the relay works the way the specs say it does.

* * *

This has been No. 113 in an endless series of messages designed to focus public attention on Sigma's sincere desire to sell relays.

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- Temperature-controlled oven contains the barretter and and ambient temperature compensating resistor. Effect of ambient temperature changes is less than 0.005%/° C from 20° C.
- Proper NIXIE digit is lighted automatically while bridge is being balanced. No jitter.
- Rugged, accurate. Doesn't require the extreme care of many laboratory standard instruments. No meter scales to read. Useful for laboratory, production line, and in the field.

specifications: **$720**

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ACCURACY: ¼% 0.1 to 300 v, 100 cps to 10 kc;
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ISA Products—cont.

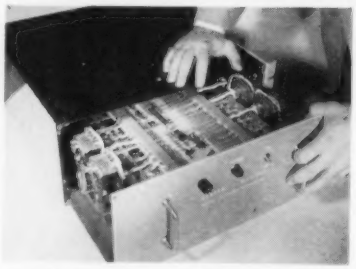
Pneumatic current transmitter 109

Type 19A pneumatic current transmitter is used on very high current applications having values in the tens or hundreds of thousands of amperes, such as experienced in the various metals industries, plating industry and chlorine manufacturing. Type 19A determines the amount of direct current flowing in a bus bar conductor and transmits a standard linear 3-15 psi pneumatic signal to a pneumatic receiver. It provides force/balance measurement of magnetic flux intensity and requires no contact or connection to any current - carrying member.

The Foxboro Co., Ltd., Montreal.

Digital telemetering system 110

Designed to meet the needs of modern utility operation, Digital Telemetering System offers utility load dispatchers a means of obtaining kilowatt hour readings showing the actual power which is

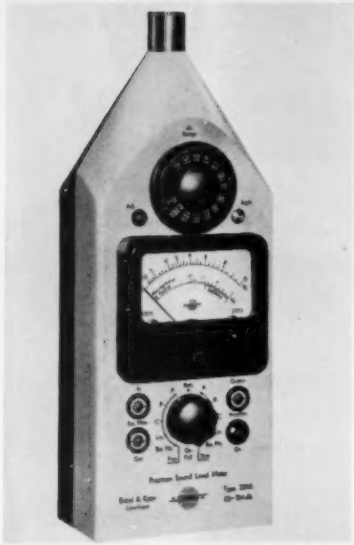


transferring in or out of the utility system. The digital telemetering signal can be time-multiplexed with an analog telemetering signal at a pre-set time interval, thus providing minimum channel expense and lower operating costs. In addition, the digital telemetering system can be used over its own isolated channel to transmit information on command. This system will also operate over any intermediate channel equipment capable of accommodating standard analog "frequency" telemetering signals.

General Electric Co., Instrument Dept., West Lynn, Mass.

Sound level meter 111

Bruel & Kjaer precision sound level meter has been built to fulfil the proposed international IEC standards for sound level meters. Equipped with a condenser microphone, the instrument gives a direct scale reading from 22 to 134 db to an accuracy of 1 db and the linear frequency characteristic ranges from 20 cps to 15 kc. An overall amplification of 110 db gives full deflection on the meter for an input voltage of 10 uv. Versatility is obtained from the meter in that it can be converted into a frequency analyzer by the connection of external 1/3 and 1/1 octave filters. A level recorder may be con-



nected to its output for a permanent record. By substituting the microphone cartridge with an adaptor it can be converted to a voltage and vibration amplifier, and by connecting an accelerometer to the input, vibration measurements can be made.

R-O-R Associates Ltd., Don Mills, Ont.

Multipoint recorder 112

Westronics miniature multipoint recorder scans, samples and prints 12 points on 5-in. chart paper at a rate of 5 seconds per point. Any one or any partial combination of the 12 points can be set for "no-print" and by-passed by means of 12 external toggle switches. The scanning selector stepping switch is packaged separately from the recorder and can be distantly remote. The print wheel and remote selector are automatically synchronized. The selector switch will "home in" even after deliberate tampering with the print wheel.

Radionics Ltd., Montreal.

Recording annunciator 113

Scam recording annunciator provides a printed record of plant events. It records selected "off-normal" and "return to normal" conditions at the command of a variety of simple contact devices such as pressure or temperature switches, limit switches, overspeed switches, and overload relays. The printed record includes the specific conditions, plus the month, day, hour, minute and second of occurence. Three basic models provide 32, 64 and 1,000 point maximums.

Sioc Ltd., Toronto.

Multipoint recorder 114

This temperature controller provides automatic control for up to 10 separate processes or operations and can be built with either a potentiometer or bridge type measuring circuit. The potentiometer instrument, model 80215, is a null-balancing measuring circuit with an electronic control system. It can be used with any primary sensing element whose output changes as a function of the measured variable. The bridge type instrument, model 80216, measures electrical resistance and may be used with primary sensing elements whose resistance is altered by the measured variable.

Thermo Electric (Canada) Ltd., Brampton, Ont.

Temperature recorder controller 115

This new series of temperature recorder-controllers is just entering the production stage after extended field testing. Designed with 6 in. charts and incorporating many features, several all-purpose models will be offered.

United Electric Controls (Canada) Ltd., Dorval, Que.

Potentiometer with push-buttons 116

Precision preset push-button potentiometer provides fifty preset millivolt output signals, giving a wide selection of thermocouple temperatures. Innovations in circuit design permit this instrument to be used in calibration of all types of thermocouple readout instruments.

Orenda Engines Ltd., Toronto.

PATENT LICENCE OFFERED

The owner of Canadian Patent No. 503,910 which relates to a method for the preparation of an organic electrically insulating coating on a metal surface particularly adapted for use with rotary and stationary electrical machinery, is prepared to grant licences for the use of the invention in Canada. The method has been in industrial use for about eight years in several countries by a number of European companies of world wide reputation. The production cost of the insulating coating amounts to about 5c a pound.

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New products—cont.

Temperature compensated capacitor 122

JFD Electronics has introduced a variable temperature coefficient capacitor, the T-C Trim, to provide compensation for variations of circuit values caused by temperature changes. Model VCJ463 is available in fixed capacitance values from 2.0 to 12.0 pf and offers an operating temperature range from —55C to +200C. Capacitance tolerance is 3% at 25C. The capacitors can be tuned to provide any temperature coefficient between —500 ppm/deg. C to +500 ppm/deg. C by adjusting an invar piston.

John R. Tilton Ltd., Toronto.

B-H meter 123

Scientific-Atlanta model 651B meter graphically displays the hysteresis loop of tape or pigment on an oscilloscope. An electronic integrator provides a B-H trace which is free from phase shift distortion. Measurements on samples as small as four strands of ¼-in. tape fall within the direct reading calibrated range of the instrument. Display adequate for qualitative inspection can be obtained from a single strand. Direct reading calibrated range of sample flux is from 3 to 1,000 maxwells with a maximum sample chamber diameter of ⅜ in. Model 651B can measure coercive force and remanence or flux at an arbitrary point.

Philips Electronics Industries Ltd., Toronto.

Automatic appliance test set 124

This automatic appliance test set has been designed for high speed testing of electric stove elements, toasters, irons and other similar devices which must have 100% inspection to meet CSA specifications. The test set comprises a CSA breakdown tester, a limit bridge and an insulation resistance tester in one enclosure with automatic sequencing equipment, and go/no-go indicator lamps. In operation, a jig makes all necessary connections simultaneously to the device under test. Other test equipment can be integrated into the test set to suit particular applications.

Canadian Research Institute, Toronto.

Universal counter timer 125

Computer Measurements model 1144A 10 Mc, universal counter-timer combines the functions of a counter, time interval meter, and frequency/period meter. It performs seven basic functions as selected by a front panel switch. The unit is direct reading and is available with either the standard vertical decade number panels or inline Nixie readout. The instrument's measurement ranges are dc to 10 Mc for frequency; 0.1 usec to 10^7 sec for time interval; 0.1 usec for period.

Electromechanical Products, Agincourt, Ont.

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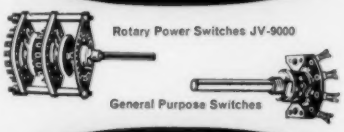

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Accuracy:	0.05% from 0.1 to 500V 0.1% or 50uv, whichever is greater below 0.1V
Null Sensitivity Ranges:	10V, 1V, 0.1V and 0.001V
Maximum Meter Resolution:	5uv
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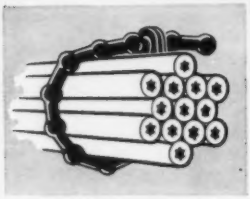

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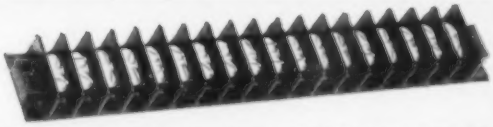

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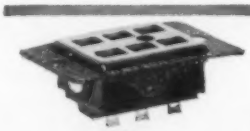

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Hon. G. Nowlan will address EIA at annual meeting

Honorable George Nowlan, Minister of National Revenue, will address the Electronic Industries Association of Canada at their annual meeting in Ottawa June 16.

The 32nd annual general meeting of the Association will be held at the Chateau Laurier, commencing at 9.30 a.m. Mr. Nowlan is scheduled to deliver his speech at 10.30.

Committees and sub-committees of EIA will hold their respective meetings at the Chateau Laurier during June 14 and 15. Registration will take place at the same time.

There will be an informal luncheon at noon, June 15. At 6 p.m. of the same day there will be a reception followed by the 32nd annual dinner. Entertainment and dancing will commence at 9.30.

Wholesalers will meet at Jasper

The sixth annual national meeting and convention of the Canadian Electronics Wholesalers' Association will be held at Jasper Park Lodge, Jasper, Alta., July 3-5. The annual Questions and Answers Symposium will be under the chairmanship of J. R. Longstaffe, Toronto. Panel members already recruited are: R. S. Thompson, C.G.E., Toronto; P. J. Heenan, Centralab Canada Ltd., Ajax; R. A. Dickson, Burgess Battery Co., Niagara Falls; G. Lyall, Philips Electronics Industries Ltd., Toronto.

The Eastern Division of CEWA will hold its annual meeting at Chicago, May 22, just prior to the opening of the Electronics Parts Show.

It is planned to hold the annual meeting of the Western Division at Jasper, July 2.

AIEE will meet at Cornell University

The Summer General Meeting of the American Institute of Electrical Engineers will be held on the Campus of Cornell University, Ithaca, N.Y., June 18-23. The occasion will be the second time Cornell has been host to such a meeting since 1935. It is expected that the Meeting will be attended by 2,000 engineers, industrialists, and educators from all parts of this country and Canada.

The Annual Meeting of AIEE will open the conclave Monday, June 19, when 1961-62 officers will be announced by the Committee on Tellers which has been tabulating a mail vote among the Institute's more than 55,000 members.

The technical program will consist of 58 sessions and symposiums that will survey latest advances and discoveries in the field of electrical engineering and the allied arts.

Technicians to hold a training week

Ontario's 1,500 engineering technicians and technologists will be in the spotlight May 29-June 2 which is Commonwealth Technician Training Week in Canada.

The event, which will be observed throughout the country, is being held under the patronage of HRH the Duke of Edinburgh.

Purpose of the event is to focus public attention on the field of technical training below the university level, including trades training and the training of engineering technicians and technologists.

Ontario is the only province in Canada to have a certification program for technicians and technologists. It was established in 1957 under the guidance of the Association of Professional Engineers of Ontario as a means of grading technically-trained persons according to qualifications and experience. There are four categories—three of technician and one of technologist, the latter being the highest technical grade.

The fourth annual meeting of technicians and technologists will be held in Toronto, at the King Edward Sheraton Hotel, May 27.

Trade promotion conference

The first of a series of Federal-Provincial trade and industrial promotion conferences will be held at London, Ont. on May 25. The one-day conference, organized in co-operation with the Ontario and Canadian Chambers of Commerce, to serve Southwestern Ontario, to which all businessmen and manufacturers in that area are invited, will deal with the many aspects of export and domestic trade. Further conferences will be organized for other areas in Ontario.

A Federal Government team will be led by the Honorable George Hees, Minister of Trade and Commerce. The Honorable W. M. Nickle, Minister, Commerce and Development, Ontario, will head the Provincial delegation.

COMING EVENTS

May

3-13 British Columbia International Trade Fair, Exhibition Park, Vancouver.

7-12 89th Society of Motion Picture and Television Engineers Convention, King Edward-Sheraton Hotel, Toronto.

8-10 National Aeronautical Electronics Conference, Dayton, Ohio.

8-12 National Industrial Production Show, Exhibition Park, Toronto.

9-17 International Exhibition on measurement, control, regulation and automation, sponsored by the French Mechanical and Electronic Manufacturers Association. Paris, France.

16-17 Annual Meeting and Conference of the Canadian Nuclear Association, Lord Simcoe Hotel, Toronto.

22-24 Electronic Parts Distributors Show, Conrad Hilton Hotel, Chicago.

May 30-June 2 Radio and Electronics Components Show, Olympia, London.

June

5-8 Instrument Society of America, Summer Conference and Exhibit, Toronto.

28-30 Joint Automatic Control Conference, IRE, ISA, AIEE, AIChE, ASME. Held at University of Colorado, Boulder, Colo.

June 15-July 2 International Exhibition of Electronics, Nuclear Energy, Radio, TV and Cinematography; Rome, Italy.

1961-62 Components and Equipment Directory

The fourth edition of CEE's annual Components and Equipment Directory will be published in June. It will contain updated listings of over 2,000 manufacturers of electronic and allied materials, components and equipment, with details of their sales representatives, and a comprehensive trade name index.

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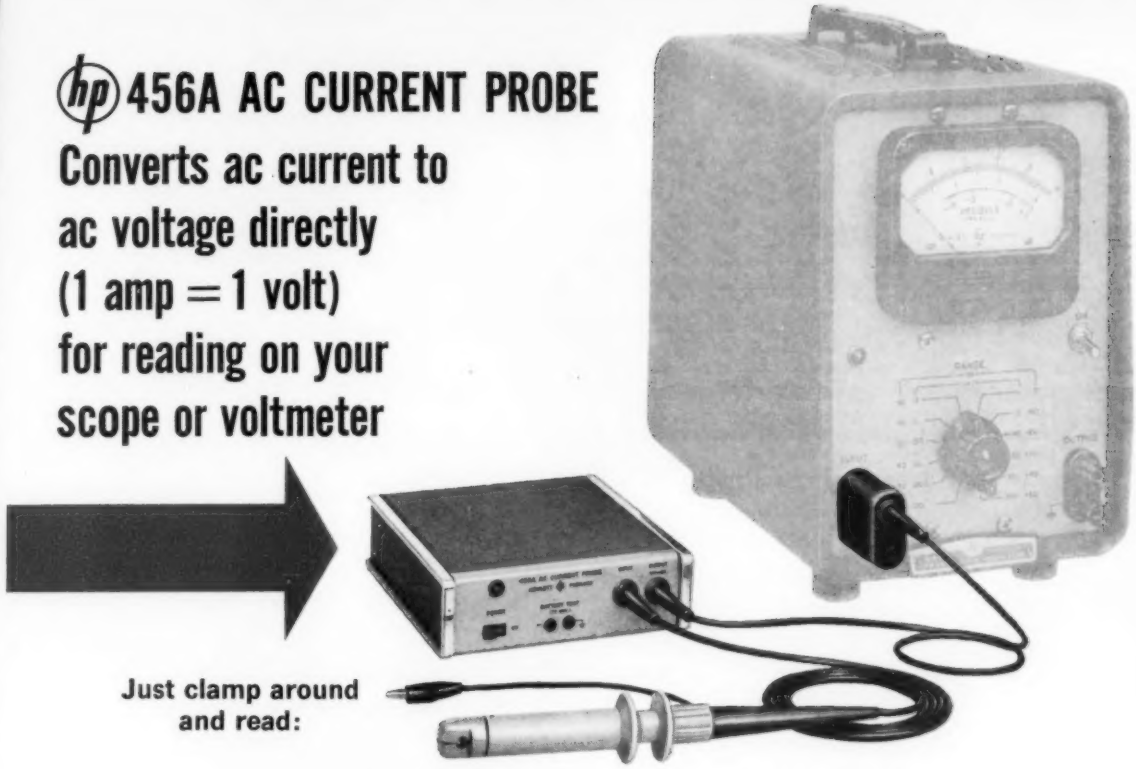

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Sensitivity: 1 mv/ma ±1% at 1 KC
Frequency Response: ±2%, 100 cps to 3 MC ±5%, 60 cps to 4 MC — 3 db at 25 cps and above 20 MC
Maximum Input: 1 amp rms; 1.5 amp peak. 100 ma rms above 5 MC
Maximum dc current: Dc up to 0.5 amp has no appreciable effect
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Size: 5" wide, 1½" high, 6" deep, weight 3 lbs.
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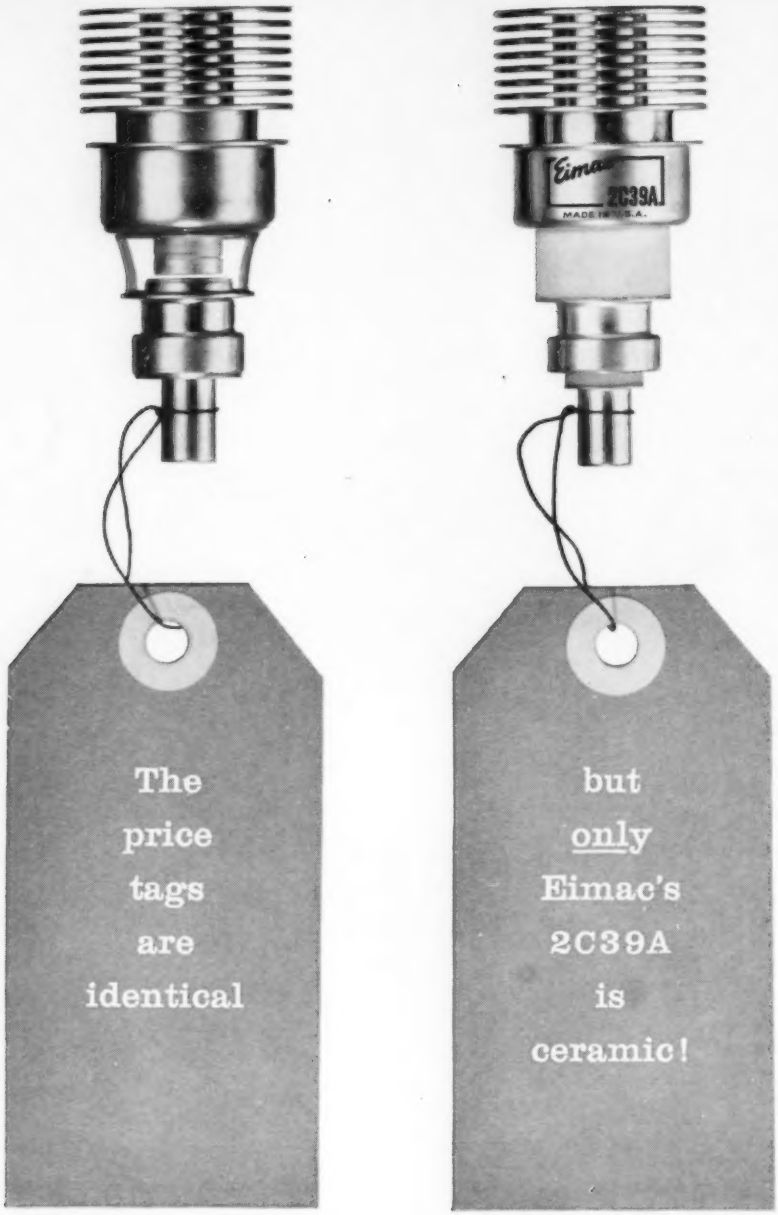

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